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# FORESTRY

# INDIANA

1912

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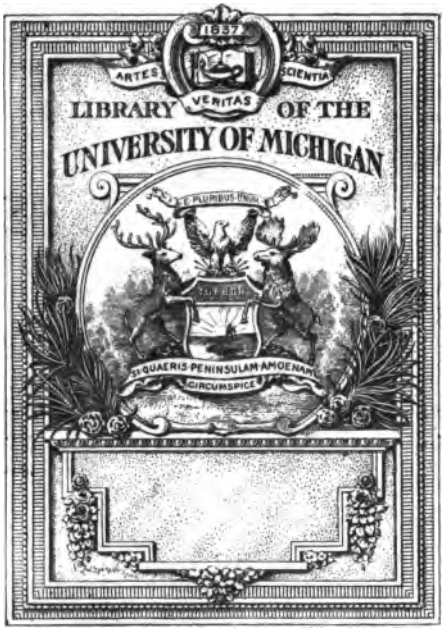


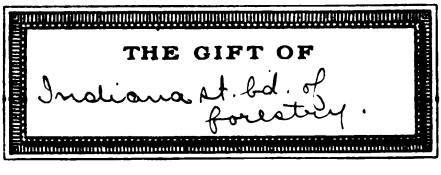


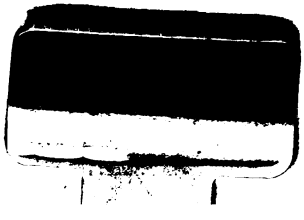

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Constitutional Elm, Corydon, Ind. Circumference breast high, 13.1 feet; longest width of crown, 113 feet; shortest width, 97 feet. It was under this tree that the Constitutional Commission held several sessions between June 10 and June 29, 1816.

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# STATE OF INDIANA

## TWELFTH ANNUAL REPORT

OF THE

# State Board of Forestry

## 1912

CHAS. C. DEAM, Secretary

To the Governor

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING
1913

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THE STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
February 1, 1913.

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

---

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, February 26, 1913.

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

W. H. O'BRIEN,
*Auditor of State*

---

FEBRUARY 26, 1913.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

B. B. JOHNSON,
*Secretary to the Governor.*

---

Filed in the office of the Secretary of State of the State of Indiana, February 26, 1913.

L. G. ELLINGHAM,
*Secretary of State.*

---

Received the within report and delivered to the printer February 26, 1913.

ED D. DONNELL,
*Clerk Printing Board.*



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# Letter of Transmittal.

INDIANA STATE BOARD OF FORESTRY,

INDIANAPOLIS, INDIANA,

December 2, 1912.

*Hon. Thomas R. Marshall:*

Sir—As required by Section 4 of the Act establishing a State Board of Forestry, approved March 1, 1901, we submit herewith the Twelfth Annual Report of the Board of Forestry, beginning with October 1, 1911, and ending with September 30, 1912.

Very respectfully,

S. BURKHOLDER, President.
CHARLES C. DEAM, Secretary.



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# Indiana State Board of Forestry.

## OFFICIAL MEMBERS, 1912.

SAMUEL BURKHOLDER, President.....Crawfordsville
STANLEY COULTER.....Lafayette
ARTHUR S. NOWELS.....Columbia City
WILLIAM M. WALTMAN.....Morgantown
CHAS. C. DEAM, Secretary.....Bluffton
EMMA L. STREIBICH, Stenographer.....Indianapolis

OFFICE OF SECRETARY.

Room 110, State House, Indianapolis.



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# Financial Statement.

OCTOBER 1, 1911 TO OCTOBER 1, 1912.

*Annual Appropriation by the General Assembly, 1909.*

| | | | |
|---|---|---|---|
| 1. | Office— | | |
| | Salary of secretary of board | $1,800 00 | |
| | Salary of stenographer to secretary | 600 00 | |
| | Salary of four board members | 400 00 | |
| | Mileage of four board members | 56 50 | |
| | General office expense and mileage | 1,000 00 | |
| | Total | | $3,856 50 |
| 2. | Forest Reservation and Experimental Station | $3,000 00 | |

*Expenditures.*

| | | |
|---|---|---|
| Office—Salary: | | |
| Chas. C. Deam, secretary of board | $1,800 00 | |
| Emma L. Streibich, stenographer to secretary | 600 00 | |
| Samuel Burkholder, board member | 100 00 | |
| Samuel Burkholder, board member, mileage | 8 80 | |
| Stanley Coulter, board member | 100 00 | |
| Stanley Coulter, board member, mileage | 18 22 | |
| Arthur S. Nowels, board member | 100 00 | |
| Arthur S. Nowels, board member, mileage | 14 40 | |
| William M. Waltman, board member | 100 00 | |
| William M. Waltman, board member, mileage | 15 08 | |
| Total | | $2,856 50 |
| Office—General Expense: | | |
| Office supplies | $192 45 | |
| Postage | 373 69 | |
| Mileage | 139 57 | |
| Hotel | 53 75 | |
| Livery | 75 90 | |
| Telephone | 40 75 | |
| Photographic supplies | 56 48 | |
| Express | 65 32 | |
| Freight | 2 09 | |
| Total | | $1,000 00 |



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Reservation Expenses:

| | | |
|---|---|---|
| Labor | $2,040 04 | |
| Household supplies, hardware and tools | 94 16 | |
| Hay and corn | 121 60 | |
| Seedlings and seed | 318 77 | |
| Construction material | 113 74 | |
| Board for board members | 12 25 | |
| Freight | 42 78 | |
| Telephone and repairing | 23 20 | |
| Carbide | 17 50 | |
| Blacksmithing | 24 60 | |
| Paints, oils and brushes | 54 45 | |
| Livery | 7 00 | |
| Express | 7 55 | |
| Surveying | 58 30 | |
| Fertilizer | 23 43 | |
| Insurance | 39 40 | |
| Postage | 1 23 | |
| Total | | $3,000 00 |

Receipts from sales at Forest Reservation and Experimental Station and remitted to State Treasurer upon recommendation of State Auditor ..... $12 40

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# Introduction.

The importance of forestry has received increased recognition both by the State and nation during the past year. Our rapidly diminishing timber supply should compel an early realization of the gravity of the subject. Forestry is yet in its infancy, and who dares predict that the advance will be adequate to meet the exigencies of the future. The forest policy, both State and national, should be more stable and not interrupted by political revolutions.

In Indiana there has been steady progress in the work of forestry, but not at all commensurate with the advance in agriculture, manufacture and education. Our farmers are employing improved methods of agriculture but are neglecting the four million acre forest crop contained in their woodlots. Our cities order streets improved, which means the construction of sidewalks and a roadbed, but provision for the planting and care of trees along the street is forgotten. Our modern education lays great stress upon the development of the artistic side of home life. A home may have costly decorations and furnishings, but if it is not surrounded by a green lawn, flowers, shrubs and trees, the occupant has neglected one thing that elevates the tide of life.

The shameful neglect of our woodlots and the demand from the more progressive woodlot owners for advice on the subject of woodlot improvement, are reasons for devoting a part of this report to the management of the woodlot. The subject is treated in a scientific manner without the use of technical terms, so that any woodlot owner may understand how to improve his woodlot and make it yield the greatest forest crop. The protective value of the woodlot, its relation to bird life, etc., are also considered. Every woodlot owner should possess a copy of this article for his future guidance.

The neglect to plant shade trees in our cities, and their barbarous treatment, should no longer be tolerated. Credit should be given to the women's clubs of the State for taking up the subject. Repeated inquiries for bulletins on the planting and care of shade trees is a hopeful sign that there is an awakening to the value of the shade tree. The 1910 report of this department contained an



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article on shade trees which was printed also as a separate. The separates have long ago been distributed and nearly all of the 1910 reports. To meet the constant demand for information on shade trees it was deemed wise to include in this report an article on shade trees that would in a great measure answer the majority of the questions asked.

This department should have a circulating forestry exhibit. There is a demand from libraries throughout the State for the loan for a few weeks of such an exhibit. The educational value of such an exhibit would be worth many times the cost. There are also opportunities to use such an exhibit at county fairs and farmers' institutes. It is hoped that funds will be appropriated to make such an exhibit possible.

The promotion of the practice of forestry will succeed most quickly through demonstration. The Forest Reserve, which is a demonstration ground, is located in the southern part of the State. The Board of Forestry appreciates the need of places in other parts of the State where the practice of forestry may be shown. A partially successful effort was made this year to establish co-operative forest plantings on the county farms of the State. However, the management of these are not wholly under the control of this department and for this reason they cannot be properly called auxiliary demonstration grounds.

In our last report the recommendation was made that the State, as fast as funds would permit, acquire by purchase such lands in the State as are not fit for agriculture and devote them to forestry. This recommendation is repeated with increased emphasis.

STATE BOARD OF FORESTRY.

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# Reservation.

The Reservation is located one mile north of Henryville in Clark County. It may be reached by going to Henryville via the Pennsylvania Railroad or by going via the Indianapolis and Louisville Electric Line. The electric line touches the east side of the Reserve and all local cars will stop at the Reservation station.

The Reservation contains two thousand acres. The tract is irregular in outline; its greatest length is about three miles east and west and its greatest width about a mile and a quarter north and south.

About six hundred acres of the northwest part lies in the "knob" region, which is about three hundred feet higher than the eastern portion. Only about twenty acres of the "knob" area has ever been cleared. Practically all of this part is too badly broken by deep ravines to ever be farmed. Near the west border, which is a mile long, a deep, and for the greater part, narrow ravine extends northwest, draining this area. Some of the secondary ravines are so deep and the slopes so steep as to make logging on a small scale unprofitable. This part of the Reservation is so far from the administration buildings and the base of supplies that it has not as yet been given any attention. By the forest road through the Reservation, which is the shortest route, it is nearly three and a half miles to the top of the "knobs," from the administration buildings, and practically five miles from the nearest railroad station. The "hill road," as the road up to the "knobs" is styled, is so steep that only very small loads can be safely hauled down it. For this reason and because the slopes of the ravines are so steep, the timber products which consist principally of crossties have been skidded down the slopes and hauled through the main ravine over a neighbor's farm to the public road. By this route it is about five miles to the nearest railroad station. If this way of egress was not permitted, logging operations on this part of the Reservation would be very difficult.

The highest portion of the "knob" is covered with scrub pine (Pinus virginiana Mill.) and chestnut oak (Quercus Prinus L.). The lower slopes and ravines are principally oak, hickory and beech.



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The part of the Reservation east of the "knobs" is rather hilly and is traversed by several irregular ravines. The soil for the greater part is a compact clay. The greater part of this area could be farmed and about three hundred acres were under cultivation when the tract was purchased. While farming is possible it would not be profitable on the greater part, because the soil is not productive. The woodland area is a second growth composed principally of white, scarlet and black oaks and black hickory.

The greater part of the work at the Reservation has been the reforesting of the cleared fields, which were in the most part not profitable for farming. The controlling idea in reforesting these fields is to plant such species as give promise of being the best for use in this State. The various species are planted and managed in different ways to determine which should be used and how the best returns may be obtained. The first planting was done in the fall of 1904, and up to December 1, 1912, forty-six tracts have been planted, having a total area of 176.85 acres. A few of the tracts have been planted long enough to give some definite idea of the final results. The progress in some of them is given in another part of this report. Additional tracts are planted each year and the species used in planting are those whose silvicultural qualities for Indiana conditions have not as yet been determined.

After the work of the spring planting, which is given in detail elsewhere, the work at the Reserve was principally the cultivation of the several forest tracts and of the corn crop. The forest tracts are pruned during the winter months, when no other work, except forest cleaning, can be done.

## FIELD CULTIVATION.

The field cultivation consisted of cultivating the trees in certain tracts and the corn crop. Corn was used as an undercrop among the trees on 23.38 acres, and one field of 5.44 acres was planted to corn which was planted to trees this fall. The season was wet and help so scarce that the corn was not planted until late. After planting, the season was not favorable for corn and a poor crop was realized. The amount and cost of cultivation in the forest tracts, which includes the cost of hoeing, are arranged in the following table. For convenience, the item of pruning is included in the same table.

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| Number of Tract. | Number of Acres. | Number of Times Hoed and Cultivated. | Cost of Hoeing and Cultivating. | | Cost of Pruning. | | Total Expense. |
|---|---|---|---|---|---|---|---|
| | | | Total. | One Acre Once. | Total. | Per Acre. | |
| 5 | 6.69 | | | | $1 50 | $0 22 | $1 50 |
| 24 | 2.89 | | | | 1 74 | 60 | 1 74 |
| 25 | 6.00 | 5 | $30 59 | $1 02 | 1 73 | 19 | 32 32 |
| 28 | 9 92 | 4 | 14 40 | 37 | | | 14 40 |
| 33 | 6.4 | 3 | 5 87 | 30 | 2 10 | 33 | 7 97 |
| 40 | 2.53 | | | | 1 48 | 58 | 1 48 |
| 43 | 5.78 | 5 | 19 54 | 68 | | | 19 54 |
| 45-N | 3. | 3 | 10 75 | 1 19 | | | 10 75 |
| 46 | 10.1 | 3 | 10 65 | 35 | | | 10 65 |
| 47 | 2.66 | 4 | 14 74 | 1 38 | | | 14 74 |
| 49 | 1.02 | 4 | 3 62 | 86 | | | 3 62 |
| 51 | .97 | 3 | 2 67 | 92 | | | 2 67 |
| 53 | 2.3 | 2 | 8 57 | 1 86 | | | 8 57 |
| Total | 60.26 | | $121 40 | $0 89 | $8 55 | $0 38 | $129 95 |

Average cost of hoeing and cultivating one acre once.....$0 89
Average cost of pruning per acre..... 38

## EXPERIMENT TO DETERMINE THE PERIODICITY OF THE GROWTH OF CERTAIN FOREST TREES.

This experiment has been conducted for the past two years and was continued during this year. The trees measured this year were the same ones used last year, except that four trees were substituted for the four broken off last year. In addition ten sycamore were measured this year.

The measurements of the growth of the terminal of the tree were taken to the nearest tenth of an inch, and the measurements were taken at intervals of fifteen days throughout the growing season. In conducting the experiment it was desired to correlate the amount of growth with the amount of rainfall, amount of sunshine and the temperature. The amount of rainfall was taken this year and is given on another page, but it was impossible to secure data on the amount of sunshine or a record of the temperature. The species measured, age and number of trees used in the experiment are as follows:

Trees number 1 to 10, yellow poplar, six years old.
Trees number 11 to 20, black locust, six years old.
Trees number 21 to 26, black walnut, eight years old.
Trees number 25 to 30, black walnut, five years old.
Trees number 31 to 35, catalpa, six years old.
Trees number 36 to 40, catalpa, four years old.
Trees number 41 to 50, chestnut oak, eight years old.
Trees number 51 to 60, chestnut, eight years old.
Trees number 61 to 70, pecan, eight years old.

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Trees number 71 to 80, coffeenut, six years old.
Trees number 81 to 85, ash, eight years old.
Trees number 86 to 90, ash, five years old.
Trees number 91 to 100, elm, five years old.
Trees number 101 to 110, sycamore, two years old.

The measurements and the date taken are as follows:

| Tree Number. | May 1. | May 15. | May 30. | June 14. | June 29. | July 14. | July 29. | Aug. 13. | Aug. 28. | Sept. 12. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .4 | 1.8 | 6.4 | 10.8 | 12.9 | 12.9 | 12.9 | 12.7 | 12.9 | 13. |
| 2 | ..... | 2. | 7.8 | 13.5 | 16.3 | 19. | 19.8 | 19.8 | 19.8 | 19.8 |
| 3 | ..... | 1.4 | 5.5 | 10. | 11.2 | 12.7 | 13.7 | 13.7 | 14.2 | 14.2 |
| 4 | ..... | 4.5 | 12. | 22.3 | 27.5 | 32.5 | 35.4 | 36. | 36.7 | 36.7 |
| 5 | ..... | 3.6 | 10.6 | 17.2 | 21.2 | 25.2 | 27.2 | 27.2 | 27.2 | 27.4 |
| 6 | ..... | .9 | 2.2 | 4. | 6. | 7.7 | 9. | 9. | 9.5 | 9.5 |
| 7 | .2 | 1.5 | 4.3 | 8. | 11.8 | 14.4 | 16.4 | 16.5 | broken | off. |
| 8 | ..... | 1.7 | 5.1 | 9.1 | 11.9 | 13.7 | 15.5 | 15.8 | 15.9 | 15.9 |
| 9 | ..... | 2.7 | 10.1 | 17.6 | 22.8 | 30.5 | 36.1 | 36 2 | 38.2 | 38.2 |
| 10 | ..... | 1 9 | 5.4 | 8.2 | 10.5 | 12.4 | 13.2 | 13.4 | 13.4 | 13.5 |
| 11 | ..... | 3. | 16.6 | 28.5 | 35. | 36.2 | 36.2 | 36.3 | 36.3 | 36.3 |
| 12 | ..... | 2.1 | 8.4 | 18.3 | 24. | 24.1 | 24.6 | 24.6 | 24.6 | 24.6 |
| 13 | ..... | 6.2 | 15.3 | 23. | 28.2 | 36.5 | 37.3 | 38. | 38. | 38. |
| 14 | ..... | 2.4 | 7. | 13.5 | 15.1 | 16.1 | 16.1 | 16.1 | 16.1 | 16.6 |
| 15 | ..... | 1.7 | 7.2 | 12.9 | 13.6 | 15.1 | 15.2 | 15.2 | 15.2 | 15.2 |
| 16 | ..... | 1.8 | 8.4 | 12.5 | 15. | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 |
| 17 | ..... | .5 | 3.5 | 7.5 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 |
| 18 | ..... | .6 | 2.9 | 8.2 | 12.5 | 14. | 14.1 | 14.1 | 14.3 | 14.3 |
| 19 | ..... | 1.1 | 6.7 | 13. | 17.2 | 19. | 19. | 19. | 19. | 19. |
| 20 | ..... | 2. | 7.4 | 12.8 | 20.7 | 27.8 | 31. | 31. | 31. | 31. |
| 21 | ..... | 5.5 | 13.6 | 16. | 17.5 | 17.8 | 17.8 | 17.8 | 17.8 | 17.8 |
| 22 | ..... | 1.2 | 3.6 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 |
| 23 | ..... | .2 | 5.9 | 6.5 | 6.7 | 7. | 7. | 7. | 7. | 7. |
| 24 | ..... | 1. | 9.4 | 10.6 | 10.8 | 10.8 | 10.8 | 10.8 | 10.8 | 10.8 |
| 25 | ..... | 1.6 | 5.7 | 5.8 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 |
| 26 | ..... | 3.5 | 9.3 | 9.7 | 10. | 10.1 | 10.1 | 10.1 | 10.1 | 10.1 |
| 27 | ..... | 3.8 | 12.7 | 15.4 | 15.3 | 16. | 16. | 16. | 16. | 16. |
| 28 | ..... | 8.4 | 17.3 | 18.4 | 18.4 | 18.4 | 18.4 | 18.4 | 18.4 | 18.4 |
| 29 | ..... | 1.5 | 8. | 9.2 | 9.7 | 10. | 10. | 10. | 10. | 10. |
| 30 | ..... | .3 | 13.2 | 15.4 | 15.8 | 16. | 16. | 16. | 16. | 16. |
| 31 | ..... | 3. | 10.1 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| 32 | ..... | 3.4 | 10.5 | 14.9 | 14.9 | 14.9 | 14.9 | 14.9 | 14.9 | 14.9 |
| 33 | ..... | 2.8 | 6.6 | 7.4 | 8.5 | 9.3 | 10. | 10. | 10. | 10. |
| 34 | ..... | 2.2 | 6.5 | 7. | 7.4 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| 35 | ..... | 3.2 | 7.9 | 8.5 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 |
| 36 | ..... | 5. | 15.5 | 21.1 | 24.1 | 27.3 | 27.6 | 27.6 | 27.6 | 27.6 |
| 37 | ..... | 6.2 | 13.3 | 18.4 | 23. | 27.4 | 27.6 | 27.6 | 27.6 | 27.6 |
| 38 | ..... | 7. | 18.1 | 26. | 28.9 | 33.5 | 34.5 | 34.5 | 34.5 | 34.5 |
| 39 | ..... | .4 | 21.4 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 |
| 40 | ..... | 8.4 | 18.2 | 23.6 | 26.2 | 27.5 | 27.5 | 27.5 | 27.5 | 27.5 |
| 41 | .7 | 6.8 | 7.1 | 9.6 | 15.2 | 17.8 | 18.5 | 18.5 | 18.6 | 18.6 |
| 42 | 3.4 | 6.5 | 7. | 7.1 | 7.1 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 |
| 43 | 1.8 | 9.3 | 9.2 | 11.6 | 12.9 | 15.5 | 15.6 | 15.6 | 15.8 | 15.8 |
| 44 | 4.5 | 7. | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| 45 | 1. | 11.9 | 12.1 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 |
| 46 | .6 | 10.2 | 10.3 | 14.2 | 24.1 | 28.2 | 28.7 | 28.7 | 28.7 | 28.7 |
| 47 | 3.6 | 9. | 9.3 | 12.6 | 19.3 | 22.7 | 23. | 23. | 23. | 23. |
| 48 | 2.3 | 7.2 | 7.3 | 8.1 | 15.6 | 23.5 | 24. | 24. | 24. | 24. |
| 49 | ..... | 6.9 | 7.2 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| 50 | 2.3 | 13.4 | 13.4 | 14.2 | 20.8 | 21.3 | 21.5 | 21.5 | 21.5 | 21.5 |
| 51 | ..... | 3.4 | 10.4 | 18.1 | 22.5 | 26.3 | 26.6 | 26.6 | 26.6 | 26.6 |
| 52 | ..... | 2.2 | 4.5 | 9. | 13. | 16. | 16. | 16. | 16. | 16. |
| 53 | ..... | 4.5 | 10.1 | 14.9 | 19. | 21.4 | 21.4 | 21.6 | 21.6 | 21.6 |
| 54 | ..... | 1.5 | 5.1 | 9.5 | 13.1 | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 |
| 55 | ..... | .4 | 2.9 | 5.2 | 8.9 | 12.9 | 12.9 | 12.9 | 12.9 | 12.9 |
| 56 | ..... | 3.8 | 8.2 | 18.5 | 25.2 | 28.4 | 28.4 | 28.7 | 28.9 | 28.9 |
| 57 | ..... | ..... | 11.7 | 17.9 | 21. | 22.1 | 22.1 | 22.1 | 22.1 | 22.1 |
| 58 | ..... | 6.8 | 11.9 | 17. | 21.6 | 25. | 25. | 25. | 25. | 25. |
| 59 | ..... | 4.8 | 13.6 | 23. | 30.1 | 31.5 | 34.6 | 34.6 | 34.6 | 34.6 |
| 60 | ..... | 3.2 | 10.1 | 15.2 | 20. | 22.6 | 23. | 23. | 23.2 | 23.2 |
| 61 | ..... | .4 | 4.3 | 6.2 | 8.3 | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| 62 | ..... | 3.5 | 5.8 | 8.1 | 13.5 | 16.6 | 16.6 | 16.6 | 17.2 | 17.2 |

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| Tree Number. | May 1. | May 15. | May 30. | June 14. | June 29. | July 14. | July 29. | Aug. 13. | Aug. 28. | Sept. 12. |
|---|---|---|---|---|---|---|---|---|---|---|
| 63 | ..... | ..... | 2.9 | 7.1 | 14. | 21.4 | 21.5 | 22. | 22. | 22. |
| 64 | ..... | 2.6 | 8.8 | 14. | 20.8 | 24.3 | 24.6 | 24.9 | 25.7 | 25.7 |
| 65 | ..... | ..... | 7.9 | 10.5 | 12. | 12.6 | 13.3 | 13.3 | 13.5 | 13.5 |
| 66 | ..... | ..... | 6.1 | 10.2 | 16.8 | 20.4 | 20.7 | 20.9 | 20.9 | 20.9 |
| 67 | ..... | 3.5 | 9. | 11.1 | 12.9 | 14.4 | 14.9 | 14.9 | 14.9 | 14.9 |
| 68 | ..... | 2.7 | 12. | 16. | 20.9 | 26.8 | 27.4 | 27.4 | 27.4 | 27.4 |
| 69 | ..... | ..... | ..... | 7.3 | 12.4 | 16.5 | 16.6 | 16.6 | 16.4 | 16.4 |
| 70 | ..... | ..... | 1.9 | 4.3 | 5. | 5. | 5. | 5. | 5. | 5. |
| 71 | ..... | 5.2 | 16. | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 |
| 72 | ..... | 11.2 | 19.8 | 19.9 | 19.9 | 19.9 | 19.9 | 19.9 | 19.9 | 19.9 |
| 73 | ..... | 7.2 | 8.7 | 9. | 9. | 9. | 9. | 9. | 9. | 9. |
| 74 | ..... | 3.7 | 9. | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 | 9.1 |
| 75 | ..... | 5.5 | 10.8 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 |
| 76 | ..... | 2.9 | 9.7 | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 | 10.5 |
| 77 | ..... | 12.5 | 29.4 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 |
| 78 | ..... | 12.3 | 20. | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 |
| 79 | ..... | 8.2 | 15.8 | 15.9 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 |
| 80 | ..... | 7.7 | 22.7 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 |
| 81 | 4.1 | 19.1 | 24.2 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 | 24.4 |
| 82 | ..... | 11. | 11.7 | 11.9 | 11.9 | 11.9 | 11.9 | 11.9 | 11.9 | 11.9 |
| 83 | .3 | 4. | 4.3 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| 84 | ..... | 10.4 | 12.1 | 12.2 | 12.2 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 |
| 85 | ..... | 16.2 | 17. | 17.5 | 17.7 | 17.7 | 17.7 | 17.7 | 17.7 | 17.7 |
| 86 | 7.8 | 16. | 21.6 | 24.7 | 25.8 | 25.8 | 25.8 | 25.8 | 25.8 | 25.8 |
| 87 | .3 | 15.1 | 25.4 | 21.4 | 27. | 27.1 | 27.1 | 27.2 | 27.2 | 27.2 |
| 88 | .4 | 8.2 | 14.3 | 16.1 | 16.1 | 16.1 | 16.1 | 16.1 | 16.1 | 16.1 |
| 89 | 1.1 | 12.6 | 18.1 | 18.2 | 18.3 | 18.3 | 18.3 | 18.3 | 18.3 | 18.3 |
| 90 | ..... | 6.7 | 10. | 10.5 | 10.1 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 |
| 91 | ..... | 6. | 6.8 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| 92 | ..... | 9.8 | 18.7 | 18.8 | 18.9 | 21.4 | 22.2 | 22.4 | 22.4 | 22.4 |
| 93 | 5.5 | 16.2 | 20. | 20.5 | 20.7 | 20.7 | 20.8 | 21. | 21. | 21. |
| 94 | 1.8 | 4.6 | 7.4 | 8. | 8.3 | 8.3 | 8.3 | 8.3 | 8.3 | 8.3 |
| 95 | 2.7 | 14.4 | 20.1 | 20.7 | 21.8 | 24.4 | 26. | 26. | 26. | 26. |
| 96 | ..... | 9.8 | 21.9 | 22. | 23.8 | 36.1 | 37. | 37.4 | 37.4 | 37.4 |
| 97 | 2.6 | 11.2 | 16.5 | 18.8 | 19. | 19. | 19. | 19. | 19. | 19. |
| 98 | 4.5 | 12.7 | 17.9 | 21. | 23.7 | 24.5 | 25. | 25. | 25. | 25. |
| 99 | 1.4 | 12.8 | 19.1 | 15.7 | 15.8 | 15.8 | 15.8 | 16.7 | 16.7 | 16.7 |
| 100 | 1.7 | 12.4 | 22.3 | 26. | 26.1 | 26.1 | 26.2 | 26.2 | 26.2 | 26.2 |
| 101 | ..... | .6 | 2.6 | 5.6 | 7.8 | 12.8 | 16.9 | 21.4 | 29.3 | 33. |
| 102 | ..... | 4.7 | 10.3 | 14.2 | 17.3 | 21. | 24.5 | 28.2 | 34.5 | 36.7 |
| 103 | ..... | 2.8 | 5.3 | 7.3 | 8.7 | 9.8 | 11. | 14. | 20. | 22.4 |
| 104 | ..... | 2. | 5.8 | 8.5 | 10.9 | 14.7 | 18. | 21.3 | 26.8 | 31.6 |
| 105 | ..... | 1.8 | 4.3 | 7. | 10.1 | 13.6 | 16.4 | 19.4 | 28.4 | 29.7 |
| 106 | ..... | 2.4 | 5.8 | 9.7 | 12.9 | 16.6 | 20. | 23.5 | 26. | 30.5 |
| 107 | ..... | 4.2 | 9. | 13.6 | 17.5 | 22.8 | 27.6 | 32.5 | 40.5 | 44.8 |
| 108 | ..... | 4. | 10.4 | 11.9 | 15.2 | 20. | 24. | 27.8 | 34.6 | 37. |
| 109 | ..... | 3.9 | 7. | 10.6 | 14.5 | 19.6 | 24. | 30. | 38.5 | 42.2 |
| 110 | ..... | 4.5 | 6. | 8.3 | 11. | 15.5 | 20.5 | 25.6 | 27. | 27. |

The average growth of the species for the fifteen-day intervals is as follows:

| | May 1. | May 15. | May 30. | June 14. | June 29. | July 14. | July 29. | Aug. 13. | Aug. 28. | Sept. 12. |
|---|---|---|---|---|---|---|---|---|---|---|
| Poplar | .06 | 2.2 | 6.9 | 12.07 | 15.21 | 18.10 | 19.90 | 20.03 | 20.90 | 20.91 |
| Locust | ..... | 2.14 | 8.34 | 15.02 | 18.85 | 21.29 | 21.74 | 21.02 | 21.84 | 21.89 |
| Walnut | ..... | 2.70 | 9.87 | 11.49 | 11.69 | 11.69 | 11.69 | 11.69 | 11.69 | 11.69 |
| Catalpa | ..... | 4.16 | 12.81 | 17.32 | 18.91 | 20.38 | 20.60 | 20.60 | 20.60 | 20.60 |
| Chestnut oak | 2.02 | 8.82 | 9.00 | 10.41 | 14.17 | 16.28 | 16.52 | 16.52 | 16.55 | 16.55 |
| Chestnut | ..... | 3.06 | 8.85 | 14.83 | 19.44 | 22.19 | 22.57 | 22.62 | 22.66 | 22.66 |
| Pecan | ..... | 1.27 | 5.87 | 9.48 | 13.66 | 16.64 | 16.90 | 17.00 | 17.14 | 17.20 |
| Coffeenut | ..... | 7.64 | 16.19 | 16.68 | 16.67 | 16.67 | 16.67 | 16.67 | 15.67 | 16.67 |
| Ash | 2.3 | 12.70 | 18.14 | 18.49 | 19.15 | 19.15 | 19.15 | 19.15 | 19.15 | 19.15 |
| Elm | 2.9 | 10.99 | 17.07 | 17.90 | 18.56 | 20.38 | 20.73 | 20.85 | 20.85 | 20.85 |
| Sycamore | ..... | 3.09 | 6.65 | 9.67 | 12.59 | 16.64 | 20.29 | 24.37 | 30.56 | 33.49 |



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The growth of the species at the end of June, expressed in the percentage of the year's growth, for the years 1911 and 1912 is as follows: It should be borne in mind, however, that last year there was practically no rain from the first of May until the middle of August.

| | Per Cent. 1911. | 1912. | | Per Cent. 1911. | 1912. |
|---|---|---|---|---|---|
| Poplar | 76 | 73 | Pecan | 92 | 80 |
| Locust | 77 | 87 | Coffeenut | 97 | 100 |
| Walnut | 87 | 99 | Ash | 99 | 100 |
| Catalpa | 83 | 92 | Elm | 61 | 89 |
| Chestnut oak | 75 | 86 | Sycamore | — | 41 |
| Chestnut | 80 | 86 | | | |

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# Field Planting.

During the year 43.76 acres of waste fields were planted to forest, which is by far the greatest number of acres planted within any one year. The total area of old fields now planted is 176.85 acres.

The spring of 1912 was very rainy and consequently very unfavorable for planting. The ground was really not dry enough to wait for favorable weather so the planting was begun the last of April. On account of the continuous rains some of the tracts were prepared as many as three times before the trees could be planted. The trees in every tract were planted when the ground was much too wet and in a few tracts they were actually "mudded in." Considering the conditions under which the planting was done and the quality of the seedlings, the percentage of the trees that lived is very high.

The tracts that were planted within the year are as follows:

## Tract 45.

This tract contains 5.8 acres and was planted with ash and tulip. The soil for the greater part is a light clay loam. The tract is divided east and west by the wagon road into two nearly equal parts. The part north of the road is quite level and slopes for the greater part to the west. The part south of the road is traversed by a deep depression, extending to the southeast.

This tract is a planting of ash and tulip or yellow poplar in a mixed stand to determine their relative ability to endure shade and also to determine whether the preparation of the ground for planting and cultivation is advantageous or not.

The trees on the whole of the tract are spaced 4 x 4 feet, and are planted alternately in the rows so that the same species do not stand opposite in successive rows. The part north of the road had not been farmed for several years and was prepared for planting as for corn. The seedlings were planted in this part with the hoe and received three cultivations during the year. The part south of the road had been farmed for the past few years in corn and was practically free from weeds. This part was disked and marked off



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in order that the trees could be correctly spaced. The trees were planted by inserting a spade in the ground, working it back and forth to loosen the earth, then dropping the seedling in the hole and firming the earth with the foot. This kind of planting is known as the "rock in" method, and the term will be used later in this report where this method of planting was employed. The trees in this part received no cultivation.

The expense of planting this tract has been unduly heavy because the continued rains made it necessary to prepare the tract twice for planting. The fact that it was so muddy when the trees were planted and that the ash seedlings were so large and crooked that it required twice the time to set the trees that it should have, also added to the cost.

A financial statement of this tract to date is as follows:

*The North Part.*

| | | |
|---|---|---|
| May 13-17. | Preparation of ground for planting | $7 50 |
| | Labor of planting seedlings | 10 00 |
| | 4,506 Tulip seedlings at $3.50 per thousand | 15 77 |
| | 4,507 Ash seedlings at $2 per thousand | 9 01 |
| June 4-July 6. | Three plowings and hoeings | 10 75 |

*The South Part.*

| | | |
|---|---|---|
| May 13-17. | Preparation of ground for planting | $4 50 |
| | Labor of planting seedlings | 7 00 |
| | 3,401 Tulip seedlings at $3.50 per thousand | 11 90 |
| | 3,401 Ash seedlings at $2 per thousand | 6 80 |
| | Total expense | $83 23 |

Because dry weather followed the planting of this tract and the seedlings were mudded in and were of poor quality, about 40 per cent. of the tulip died. Practically all of the ash seedlings lived.

## TRACT 46.

This tract contains 10.1 acres and was planted to black locust. It was an old cleared field, oblong in shape, which has not been farmed for several years. The soil is a clay loam. The surface is rolling, the greater part being high ground. A depression crosses the tract just north of the center, extending from the northwest to the southeast. The extreme southwest and southeast corners are also low ground.

The planting of this tract with black locust in a pure stand is to determine the proper spacing and the value of cultivation. Five

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rows of volunteer seedlings were planted near the middle of the tract to determine whether trees grown from volunteer seedlings are freer from the attack of the locust borer than those grown from nursery seedlings.

The tract was divided as near the center as possible, east and west and north and south into four nearly equal parts. The east half of the tract was planted 5x5 feet and the west half 4x4 feet. The north half was not cultivated, while the south half received three cultivations.

The whole of the tract was prepared as for corn and marked out both ways. The trees were dropped in the intersections by boys and planted by men with hoes. The seedlings used in this tract were 24 inches long and were purchased in Nebraska. They were of excellent quality and arrived in good condition. The volunteer seedlings were dug from along the roadside in Jefferson County.

The result of the year's growth shows that the trees on the cultivated part are almost twice as large as those on the part that was not cultivated. The nursery seedlings also are nearly twice as high as the volunteer seedlings the difference no doubt is due to the fact that the nursery seedlings had the better root system.

The locust twig borer has injurer about 1 per cent. of the trees.

A part of each quarter of the tract will not be pruned and the remainder will be pruned to contrast the natural and artificial pruning.

The financial statement of the tract to date is as follows:

| | | |
|---|---|---|
| May 2. | Preparation of the ground for planting..... | $33 90 |
| | Labor of planting seedlings..... | 20 50 |
| | 21,984 seedlings from nursery at $3 per thousand | 65 95 |
| | 700 seedlings dug from roadside..... | 5 75 |
| June 10-July 9. | Three cultivations ..... | 10 65 |
| | Total ..... | $136 75 |

## TRACT 47.

This tract contains 2.66 acres and was planted to linn or basswood. The general form of the tract is rectangular. It was a cleared field which was planted to corn last year. The surface is nearly level with a southwest aspect. The soil is a rather porous clay loam.

This tract was planted with linn for the permanent stand, 8 x 8 feet on the quincunx plan. When the linn are large enough to compete, black locust will be planted at the 4-foot intervals be-

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tween the linn. It is planned when the tract needs thinning to remove the locust, which is expected to be of sufficient size to make posts and stakes.

The tract was prepared for planting as for corn and the seedlings planted with hoes. The tract was undercropped with corn and cultivated four times during the season. The seedlings came from Nebraska and arrived in good condition. The trees have done well for this species and practically every seedling lived.

The financial statement of this tract to date is as follows. The credit of the undercrop is based on the current local market.

| | | | |
|---|---|---|---|
| May 3, 1912. | Preparation of the ground for planting | | $8 55 |
| | Labor of planting seedlings | | 3 82 |
| | 1,664 seedlings at $15 per thousand | | 24 96 |
| | 150 pounds fertilizer | | 1 87 |
| | Planting corn and seed corn | | 1 25 |
| June 12-July 12. | Four cultivations | | 12 24 |
| | Total | | $52 69 |
| Credited by 13 bushels of corn at 40 cents per bushel | | $5 20 | |
| Credited by 37 shocks of fodder at 5 cents per shock | | 1 85 | |
| | | | 7 05 |
| | Total expense to date less credits | | $45 64 |

## TRACT 49.

This tract contains 1.02 acres and was planted with wild cherry. The soil for the greater part is a compact clay. The surface has a southeast aspect. The area was a cleared field and was planted to corn for the past few years.

The tract was planted with wild cherry for the permanent stand, 8 x 8 feet on the quincunx plan. It is planned to plant locust at the 4-foot intervals between the wild cherry, when the latter are able to compete with the locust. The locust are to be removed when the planting needs thinning.

The tract was prepared for planting as for corn and the seedlings were planted with hoes. The tract was undercropped with corn and received four cultivations during the season. The seedlings were purchased in Nebraska and arrived in good condition. The number ordered was not enough to plant the tract and it will be finished next spring. The seedlings practically all lived and showed a good growth.

The financial statement of the tract for the year is as follows:

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| | | | |
|---|---|---|---|
| May 2. | Preparation of the ground for planting | | $3 90 |
| | Labor of planting the seedlings | | 1 24 |
| | Labor of planting corn, and seed corn | | 70 |
| | 75 pounds fertilizer | | 93 |
| | 400 seedlings, 12-18 inch | | 4 00 |
| May 2–July 24. | Four cultivations | | 3 62 |
| | Total | | $24 39 |
| Credited by 2 bushels of corn at 40 cents per bushel | | $0 80 | |
| Credited by 6 shocks of fodder at 5 cents per shock | | 30 | |
| | | | 1 10 |
| | Total expense to date less credits | | $23 29 |

## TRACT 50.

This tract contains 3.14 acres and was planted with white oak. It was a wornout field which had grown up in bushes. It was planted after cleaning with an ax, to contrast with tract No. 57, which was not cleaned before planting. The tract was formerly wooded with white, black and post oak as the principal stand. The soil is a compact clay. The tract is traversed by a ravine which begins at the northwest corner and extends southeast, dividing it into two nearly equal parts. The surface drainage is good.

To facilitate planting and in order that the nuts could be planted in straight rows the tract was marked off with a single shovel into rows four feet apart.

Ten bushels of nuts were ordered to plant this tract and No. 57. The nuts on arrival were given the gravity test and 6¼ bushels floated. A good many of the nuts were "stung."

The east half of the tract was planted with nuts that floated and four nuts were planted in a hill. The west half was planted with the heavy nuts and three nuts were used in a hill. The nuts were covered from one to one and a half inches deep. The nuts for the planting were obtained from east of the Alleghany mountains, because the white oak did not fruit in our area last year.

Very few of the nuts germinated, which may have been either on account of the poor quality of the seed or because of their having been covered too deep. The planting was ill-advised last year, not only because of the quality of the seed but also on account of the high price of the nuts. The tract was replanted in October, 1912, with seed obtained from Putnam County, Indiana. These seeds were given the gravity test and only 14 per cent.

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floated. The seed were planted by workmen who made a seed bed by loosening the ground with a hoe and pressing the three seeds into the earth with the foot.

The financial statement to date is as follows:

| | | |
|---|---|---|
| Nov. 25, 1911. | Labor planting nuts, 27 hours at 17½ cents..... | $4 72 |
| | Marking off ground..... | 1 62 |
| | 4 bushels nuts at $2.75 per bushel..... | 11 80 |
| Oct. 24, 1912. | Labor planting nuts, 58 hours at 17½ cents..... | 9 86 |
| | 5 bushels sound nuts at $1.30 per bushel delivered | 6 50 |
| | Total expense ..... | $34 50 |

## TRACT 51.

This tract contains .97 acres and is planted to cottonwood (Populus deltoides). The soil is a compact clay with poor drainage, although the east border is a small stream. The tract is a small "flat" along a creek. The tract was prepared as for corn and marked out both ways 4 x 4 feet. The seedlings were planted in the intersections with hoes. The seedlings came from Nebraska and arrived in good condition. Although the tract was cultivated four times during the season, the seedlings did not grow much. This may have been because the seedlings were very spindling and were planted when the ground was extremely wet. However, practically every seedling lived.

The financial statement to date is as follows:

| | | |
|---|---|---|
| May 4, 1912. | Preparation of ground for planting..... | $3 60 |
| | Labor planting seedlings..... | 3 00 |
| | 2,717 cottonwood seedlings, 12-18 inch, at $1.70.. | 4 61 |
| June 14–July 24. | Four cultivations ..... | 2 67 |
| | Total expense ..... | $13 88 |

## TRACT 53.

This tract contains 2.3 acres and was planted to white pine. It was a part of a cleared field and begins on the east side at the top of a sterile hill and extends westward to a small creek. About one-half of the tract is low and flat. The soil is a clay and the hillside is quite sterile.

This is an experiment in planting a cleared field which contains both high and low ground to white pine without giving the seedlings any artificial shade.

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The ground was prepared as for corn and marked out both ways 3½ x 3½ feet. On account of the rainy season the tract was prepared three times before it could be planted and when the planting was done it was decidedly too wet in the low ground. Three-year old seedlings were planted in the intersections with hoes. The seedlings were obtained from Michigan and arrived in good condition but were short 700 of what was ordered, which left a fraction of the tract not planted. A double-shovel was run north and south between the rows twice during the season, not so much to cultivate the trees as to preserve the identity of the rows for replanting. The weeds were permitted to grow up around the trees to shade them, except on the north side, where they were cut down with hoes. It is estimated that 60 per cent. of the seedlings survived the season.

The financial statement to date is as follows:

| | | |
|---|---|---|
| May 2–14, 1912. | Preparing the ground for planting | $9 00 |
| | Labor planting the seedlings | 8 00 |
| | 8,500 3-year-old white pine seedlings at $2.50 | 21 25 |
| | Box and transportation on trees | 3 30 |
| June 10–July 10. | Two plowings and one hoeing | 8 57 |
| | Total expense | $50 12 |

TRACT 55.

This tract contains 4.96 acres and is planted to shellbark hickory (Hicoria ovata). The greater part of the tract is low and flat. The east side is the base of a white-black oak ridge and the west side is bounded by a creek. The general aspect is that of a western slope.

The purpose of this tract is to determine with what success a cleared field may be planted to hickory in the fall. The ground was prepared for planting as for corn and marked out both ways 4 x 4 feet. The nuts were dropped in the intersections and covered from 1 to 1½ inches deep. Seven bushels of the nuts used were obtained from southern Ohio. When given the gravity test, 4¼ bushels floated, and when sorted to detect wormy nuts, ½ gallon of such were found. Two bushels were obtained from near Henryville, Indiana. When given the gravity test three gallons floated and when sorted ½ gallon was found to be wormy. The wormy nuts were not planted. In this planting five nuts were planted to each hill, two heavy and three light. At the end of this year about 40 per cent. of the hills contained a seedling, and it is expected that seed-

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lings will appear later in the remainder of the intersections. The rodents did some damage in this tract last year before freezing weather.

The financial statement of this tract is as follows:

| | | |
|---|---|---|
| Oct. 16, 1911. | Preparation of the ground | $8 25 |
| | Labor planting the nuts | 7 09 |
| | 7 bushels of nuts | 18 60 |
| | Total expense | $33 94 |

## TRACT 56.

This tract contains 3.16 acres and was planted to burr oak. The surface is low and flat and the soil is a clay, locally known as "crayfish" land.

This tract represents an attempt to reforest a cleared field with burr oak by planting the seed in the fall. The ground for planting was prepared as for corn, and marked out both ways 4 x 4 feet. The advantages of preparing the ground by plowing are, that it gives the nuts a more favorable chance for growing the first year and the work of planting can be more quickly done. Then, too, the mice are liable to do more damage when the ground is thickly covered with weeds. It is questionable, however, whether the advantages will justify the additional expense. Three nuts were dropped in each intersection and covered 1-1½ inches deep. The nuts were collected in Putnam County near Russellville.

In the winter mice took a few of the seeds and late in the spring just as the seedlings were peeping through the ground, the ground-hogs found the tract and did destructive work. In spots they robbed every hill. It is believed that every hill would contain a seedling if it had not been for mice and ground-hogs. The present stand is about 40 per cent.

In the fall of 1912, the tract was gone over and the hills not containing seedlings were again planted. This took considerable time, since the young seedlings were not as high as the weeds. Three seeds were planted in each hill. The ground was first loosened with a hoe, the seed dropped on the loose ground and pushed into the earth by tramping.

The high price paid for seed the first year was due to the fact that the crop of this species was practically a failure which made the seed hard to procure. It will be noted that more bushels of

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seed were used to replant than were used for the original planting. This is accounted for by the fact that the seed used for replanting were much larger.

The financial statement of this tract is as follows:

| | | |
|---|---|---|
| Oct. 15, 1911. | Preparation of the ground | $11 03 |
| Dec. 8, 1911. | Labor planting nuts, 36 hours at 17½ cents | 6 30 |
| | 14½ bushels of nuts, delivered | 31 00 |
| Oct. 28, 1912. | Labor planting nuts, 42½ hours at 17½ cents | 7 44 |
| | 15 bushels of nuts, at $1.13, delivered | 16 95 |
| | Total | $72 72 |

## TRACT 57.

This tract contains 2.75 acres and is planted to white oak. The tract is really a hillside with a northeast aspect and is surrounded by woods. The greater part was originally wooded with white and black oak, the higher part with post and black jack oak.

This tract represents an attempt to reforest a wornout field, which had grown up in sassafras, sumac, blackberries, etc., with white oak, without antecedent cleaning. The greater part of the tract was fairly clear, since the bushes had formed clumps only in scattered patches.

The seed was planted with hoes, three in a hill and covered about an inch deep. They were planted approximately 4 x 4 feet. The seed was a part of the lot used in tract No. 50. This planting was an entire failure and it was necessary to replant it. This was done in the fall of 1912. The seed was planted with hoes and spaced as in the first planting. The ground was loosened up with a hoe, the seed dropped and pushed into the ground with the foot. By making a seed-bed for the nuts it took more than twice as long to plant them as it did the first time. The seed for this planting was obtained from Putnam County, Indiana.

The financial statement for this tract is as follows:

| | | |
|---|---|---|
| Nov. 22, 1911. | Planting nuts 27 hours at 17½ cents | $4 72 |
| | 4¾ bushels of nuts at $2.95 per bushel, delivered | 14 00 |
| Oct. 26–28, 1912. | Planting nuts, 52 hours at 17½ cents | 9 10 |
| | 4½ bushels of sound nuts at $1.30 net delivered | 5 85 |
| | Total | $33 67 |

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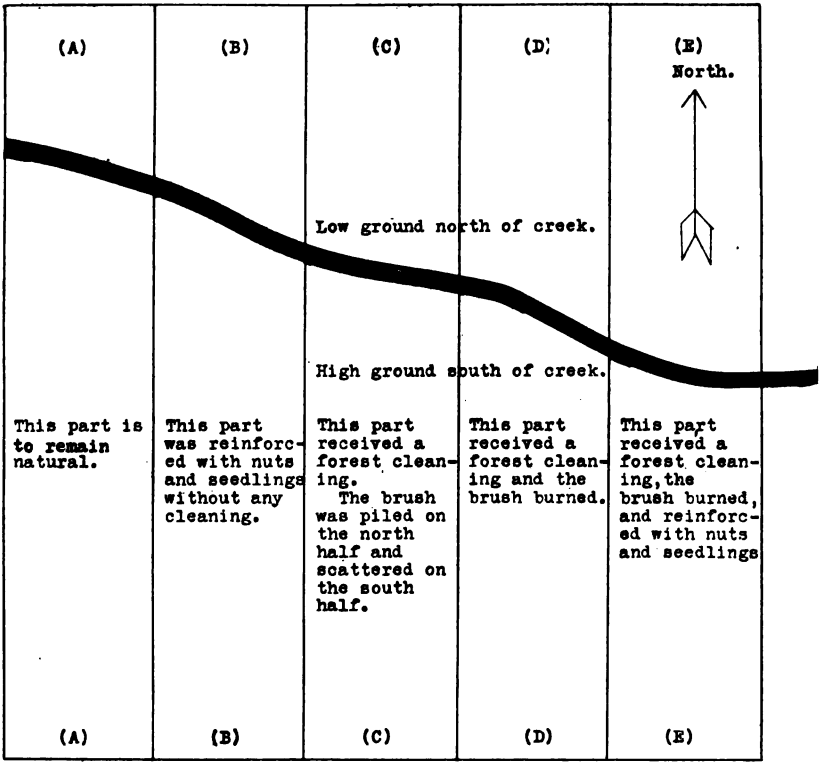
## TRACT 58.

Upon this tract the purpose is to determine experimentally the most profitable method of managing a second growth woodland. An area of ten acres in the form of a square was selected for this experiment. This was divided into five equal parts which are designated as compartments A, B, C, D and E, each part extending


(A)
(B)
(C)
(D)
(E)
North.
Low ground north of creek.
High ground south of creek.
This part is to remain natural.
This part was reinforced with nuts and seedlings without any cleaning.
This part received a forest cleaning. The brush was piled on the north half and scattered on the south half.
This part received a forest cleaning and the brush burned.
This part received a forest cleaning, the brush burned, and reinforced with nuts and seedlings
(A)
(B)
(C)
(D)
(E)

DIAGRAMMATIC DRAWING OF WOODLAND TRACT NO.58.
Plate No.1.

across the tract. The tract selected has diverse conditions but the parts are uniform. The south part is high and the north is low. The surface is rolling with an average elevation of about 600 feet. The soil is a compact clay and is locally known as "white-black" oak land. The tract was burned over in 1891, which injured nearly all of the trees. Later all of the merchantable timber was removed and a few trees old enough to produce seed were left. Since the

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fire the tract has not been pastured and no attempt has been made to regenerate it.

The diagrammatic drawing shows the plan of this experiment. Compartment A is to receive no attention and is to remain as when surveyed. Compartment B is to receive no cleaning, but it to be reinforced with seed and seedlings. Compartment C received a forest cleaning and is to be left to natural regeneration. The green material that was cut on this compartment was scattered on the south half and on the north half was piled in small piles. This was done to demonstrate that brush would rot quicker if scattered than if piled and that in case of fire the damage would be less. Compartment D was given a forest cleaning and the brush burned and then was left for natural regeneration. Compartment E was given a forest cleaning, the brush burned and is to be reinforced with nuts and seedlings. The plan to reinforce parts B and E with seedlings was only partially carried out this year and will be completed in the spring of 1913. Last year there was no crop of acorns and the hickory nuts which were stratified for spring planting were taken by rodents. It was planned in doing the spring planting on the Reserve to utilize any surplus seedlings that might be left from other plantings to reinforce parts B and E. The seedlings arrived in a bad condition and there were not enough good seedlings left to thoroughly reinforce these parts. This work will be completed next spring. There was a surplus of acorns left from other plantings this fall, which were planted in this tract.

The financial statement of each part for the year is as follows:

*Compartment A.*

No expense on this compartment.

*Compartment B.*

| | | |
|---|---|---|
| Mar. 18, 1912. | Planting nuts 4 hours at 17½ cents | $0 70 |
| Mar. 18, 1912. | ½ bushel walnuts | 35 |
| May 9, 1912. | Planting trees, 3 hours at 17½ cents | 52 |
| May 9, 1912. | 200 locust seedlings | 60 |
| Oct. 30, 1912. | Planting nuts, 26 hours at 17½ cents | 4 55 |
| Oct. 30, 1912. | 2¼ bushels white oak acorns at $1.30 delivered | 2 92 |
| Nov. 9, 1912. | Planting walnuts, 2½ hours at 17½ cents | 43 |
| Nov. 9, 1912. | 1 bushel hulled walnuts | 50 |
| | Total | $10 57 |

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*Compartment C.*

| | | |
|---|---|---|
| 1912. | | |
| Feb. 29–Mar. 14. | Cleaning, 55½ hours at 17½ cents | $9 71 |
| | Piling brush, 10 hours at 17½ cents | 1 75 |
| | Cutting wood, 6 hours at 17½ cents | 1 05 |
| | Total | $12 51 |
| Credited with 1 cord of wood at $1 per cord | | 1 00 |
| | | $11 51 |

*Compartment D.*

| | | |
|---|---|---|
| 1912. | | |
| Jan. 26–Mar. 20. | Cleaning, 40 hours at 17½ cents | $7 00 |
| | Burning brush, 37 hours at 17½ cents | 6 47 |
| | Cutting wood, 47 hours at 17½ cents | 8 22 |
| | Total | $21 69 |
| Credited with 8 cords of wood at $1 per cord | | 8 00 |
| | | $13 69 |

*Compartment E.*

| | | |
|---|---|---|
| 1912. | | |
| Jan. 23–Mar. 14. | Cleaning, 40½ hours at 17½ cents | $7 08 |
| | Burning brush, 30½ hours at 17½ cents | 5 34 |
| | Cutting wood, 85 hours at 17½ cents | 14 87 |
| May 7–17. | Planting trees, 28½ hours at 17½ cents | 4 98 |
| | Planting trees, 10½ hours at 7½ cents | 78 |
| | 1,967 tulip trees, 12-24 inch, at $3.50 | 6 87 |
| | 600 locust, 18-24 inch, at $3 | 1 80 |
| | 102 sweet gum, 24-36 inch, at $4 | 41 |
| | 339 ash, 18-24 inch, at $2 | 68 |
| | 621 cottonwood, 12-18 inch, at $1.70 | 1 06 |
| | 127 basswood | 1 80 |
| Nov. 1, 1912. | Planting nuts, 23½ hours at 17½ cents | 4 11 |
| | 2½ bushels white oak acorns at $1.30 | 3 25 |
| | Total | $53 03 |
| Credited with 16 cords of wood at $1 per cord | | 16 00 |
| | | $37 03 |

By the term forest cleaning, as applied to this tract, is meant the removal of all undesirable material, such as dead, defective and surplus trees, vines, bushes and all trees of a low commercial value, such as dogwood, ironwood, redbud, sassafras and sumac.

In order to obtain an idea of the kind, size and amount of the green material removed, the amount removed from an average half acre of compartment C was tabulated and is as follows:

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*Coppiced Sprouts.*

| | 1 in. | 2 in. | 3 in. | 4 in. |
|---|---|---|---|---|
| White Oak..... | 257 | 74 | 7 | 1 |
| Black Oak..... | 67 | 19 | 2 | 3 |
| Scarlet Oak... | 52 | 19 | 4 | .. |
| Post Oak..... | 9 | 5 | .. | .. |
| Hickory ..... | 175 | 2 | .. | .. |
| Maple ..... | 5 | .. | .. | .. |
| Sassafras ..... | 2 | .. | .. | .. |
| Ironwood ..... | 2 | .. | .. | .. |
| Black Gum.... | 3 | .. | .. | .. |
| Dogwood ..... | 41 | 1 | .. | .. |
| Sumac ..... | 18 | .. | .. | .. |
| Grapevine ..... | 19 | .. | .. | .. |
| Greenbrier .... | 64 | .. | .. | .. |
| Blackberry .... | 2 | .. | .. | .. |
| Total ..... | 716 | 120 | 13 | 4 |

*Seed Sprouts.*

| | 1 in. | 2 in. | 3 in. | 4 in. |
|---|---|---|---|---|
| White Oak..... | 13 | 1 | .. | .. |
| Black Oak..... | 2 | 2 | .. | .. |
| Scarlet Oak.... | 1 | .. | .. | .. |
| Post Oak ..... | 2 | .. | 1 | .. |
| Hickory ..... | 71 | .. | 1 | .. |
| Maple ..... | 2 | .. | .. | .. |
| Sassafras ..... | 84 | .. | .. | .. |
| Ironwood ..... | 1 | .. | .. | .. |
| Dogwood ..... | 16 | 1 | .. | .. |
| Sumac ..... | 334 | .. | .. | .. |
| Grapevine ..... | 10 | .. | .. | .. |
| Greenbrier .... | 11 | .. | .. | .. |
| Total ..... | 547 | 4 | 2 | 0 |

In order to get an idea of the composition and size of the stand of each compartment, in October of 1912 one-half acre of each was calipered. A strip from the east side of each compartment, two rods wide, extending the full length of the compartment, which is forty rods long, was selected. The circumference of every tree and shrub was taken breast-high.

The measurements of compartment A, which received no forest cleaning, and compartment E, which was cleaned, are given. A comparison readily shows how many "weed trees" and defective ones there are, which should be removed.

The following is a table of the measurements and stand on half an acre of compartment A:

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| Total Number Trees. | Circumference. | Quercus alba. White oak. | Quercus coccinea. Scarlet oak. | Quercus rubra. Red oak. | Quercus stellata. Post oak. | Quercus velutina. Black oak. | Carya glabra. Black hickory. | Carya ovata. Shellbark hickory. | Acer rubrum. Red maple. | Fraxinus americana. White ash. | Nyssa sylvatica. Black gum. | Padus serotina. Wild cherry. | Pinus virginiana. Scrub pine. | Populus grandidentata. Quaking asp. | Sassafras variifolium. Sassafras. | Cynoxylon floridum. Dogwood. | Ostrya virginiana. Ironwood. | Rhus glabra. Sumac. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1.1 | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | 1 | .... |
| 36 | 1.2 | .... | .... | .... | .... | .... | 14 | 2 | 2 | .... | 4 | .... | .... | .... | 1 | 3 | 4 | 6 |
| 74 | 1.3 | 3 | 2 | 1 | .... | 1 | 17 | 2 | 5 | .... | .... | .... | .... | .... | 2 | 3 | 5 | 33 |
| 99 | 1.4 | 7 | 1 | 2 | .... | 1 | 25 | 4 | 7 | .... | 3 | .... | .... | .... | 1 | 5 | 3 | 40 |
| 131 | 1.5 | 10 | 2 | 1 | .... | 1 | 28 | 3 | 6 | .... | 2 | .... | .... | .... | 7 | 5 | 10 | 56 |
| 104 | 1.6 | 13 | .... | .... | .... | 2 | 32 | 3 | 2 | .... | 3 | .... | .... | .... | 2 | 3 | 6 | 38 |
| 101 | 1.7 | 11 | 2 | 2 | .... | 2 | 20 | 7 | 3 | .... | 2 | .... | .... | .... | 7 | 9 | 5 | 31 |
| 89 | 1.8 | 8 | 1 | .... | .... | .... | 15 | 3 | 2 | .... | 4 | .... | 1 | .... | 4 | 7 | 10 | 35 |
| 77 | 1.9 | 11 | 2 | 1 | .... | .... | 11 | 5 | 5 | .... | 3 | .... | .... | .... | 1 | 5 | 2 | 30 |
| 114 | 2. | 19 | 4 | 1 | .... | 1 | 22 | 5 | 1 | .... | 2 | .... | .... | .... | 4 | 7 | 3 | 45 |
| 80 | 2.1 | 14 | 3 | 1 | .... | .... | 23 | 6 | 2 | 1 | 1 | .... | .... | .... | 2 | 8 | 4 | 15 |
| 48 | 2.2 | 5 | .... | .... | .... | 1 | 17 | 4 | 3 | .... | 3 | .... | .... | 1 | 3 | 3 | 1 | 7 |
| 39 | 2.3 | 12 | 1 | 1 | .... | .... | 8 | 5 | 1 | .... | 1 | .... | 1 | .... | 1 | 3 | 1 | 4 |
| 51 | 2.4 | 17 | 3 | 4 | .... | .... | 7 | 2 | .... | .... | 2 | .... | .... | .... | 2 | 3 | 4 | 7 |
| 64 | 2.5 | 20 | 1 | 1 | .... | 5 | 15 | 6 | 1 | .... | 1 | .... | .... | .... | 2 | 6 | 2 | 4 |
| 41 | 2.6 | 13 | 1 | 1 | .... | .... | 9 | 3 | 1 | .... | .... | .... | .... | .... | 2 | 7 | .... | 4 |
| 37 | 2.7 | 14 | 3 | .... | .... | 1 | 6 | 2 | 1 | .... | .... | .... | .... | .... | 1 | 6 | 2 | 1 |
| 41 | 2.8 | 20 | .... | 1 | .... | 1 | 6 | 6 | 2 | .... | 2 | .... | .... | .... | .... | 3 | 2 | 1 |
| 28 | 2.9 | 9 | 1 | 1 | .... | .... | 4 | 1 | .... | .... | .... | .... | .... | .... | 3 | 9 | .... | .... |
| 56 | 3. | 30 | 5 | 3 | .... | 1 | 5 | 5 | 2 | .... | .... | .... | .... | .... | 2 | 2 | 1 | .... |
| 20 | 3.1 | 10 | 1 | 1 | .... | 1 | 1 | .... | 1 | .... | .... | .... | .... | .... | 1 | 3 | 1 | .... |
| 32 | 3.2 | 17 | 1 | 1 | .... | 3 | 1 | 2 | 1 | .... | .... | .... | .... | .... | 1 | 4 | .... | 1 |
| 28 | 3.3 | 14 | 4 | 2 | 1 | .... | 1 | 2 | .... | .... | .... | .... | 1 | .... | 1 | 1 | 1 | .... |
| 26 | 3.4 | 17 | .... | 1 | .... | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | 5 | .... | 1 |
| 38 | 3.5 | 28 | 2 | 2 | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | 2 | 2 | .... | 1 |
| 23 | 3.6 | 18 | 2 | .... | .... | .... | .... | 1 | .... | .... | .... | 1 | .... | .... | .... | 1 | .... | .... |
| 19 | 3.7 | 13 | 4 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... |
| 22 | 3.8 | 13 | 4 | 1 | .... | 4 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 15 | 3.9 | 10 | 2 | .... | .... | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... |
| 16 | 4. | 10 | 1 | 2 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | 1 | 1 | .... | .... |
| 16 | 4.1 | 11 | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | 1 | 1 | 1 | .... |
| 14 | 4.2 | 7 | 4 | 1 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... |
| 12 | 4.3 | 6 | 3 | 1 | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 14 | 4.4 | 9 | .... | 1 | 1 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... |
| 19 | 4.5 | 12 | 3 | .... | 2 | 1 | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... |
| 7 | 4.6 | 5 | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... | .... |
| 8 | 4.7 | 6 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 11 | 4.8 | 7 | 2 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... |
| 10 | 4.9 | 7 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... |
| 6 | 5. | 6 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 4 | 5.1 | 2 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 9 | 5.2 | 6 | 2 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 7 | 5.3 | 3 | 1 | .... | .... | 2 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 6 | 5.4 | 3 | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | 1 | 1 | .... | .... | .... | .... |
| 13 | 5.5 | 10 | 2 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 5.6 | 1 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 5.7 | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 10 | 5.8 | 7 | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 5 | 5.9 | 1 | 3 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 6 | 6. | 4 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 6 | 6.1 | 2 | 1 | 1 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 5 | 6.2 | 1 | 3 | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 6.3 | 1 | .... | .... | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 6.4 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 6.6 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 6.7 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 6.8 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... |
| 1 | 6.9 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 7. | 1 | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 7.2 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 7.3 | 1 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... |
| 6 | 7.5 | .... | 5 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 7.6 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 7.7 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 7.8 | .... | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 2 | 7.9 | .... | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 3 | 8. | 1 | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 8.2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... |
| 1 | 8.4 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |

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| Total Number Trees. | Circumference. | Quercus alba. White oak. | Quercus coccinea. Scarlet oak. | Quercus rubra. Red oak. | Quercus stellata. Post oak. | Quercus velutina. Black oak. | Carya glabra. Black hickory. | Carya ovata. Shellbark hickory. | Acer rubrum. Red maple. | Fraxinus americana. White ash. | Nyssa sylvatica. Black gum. | Padus serotina. Wild cherry. | Pinus virginiana. Scrub pine. | Populus grandidentata. Quaking asp. | Sassafras varifolium. Sassafras. | Cynoxylon floridum. Dogwood. | Ostrya virginiana. Ironwood. | Rhus glabra. Sumac. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 8.5 | 1 | ... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... |
| 1 | 8.9 | ... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 9.5 | 1 | ... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 9.6 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 10.2 | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 10.5 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 11.6 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 12.5 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 2 | 13.3 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 14.4 | .... | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 14.6 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 15. | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 17.3 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 17.8 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 18.8 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 19.8 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 23.3 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 24.5 | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1 | 24.9 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 1,801 | ..... | 528 | 113 | 37 | 8 | 47 | 288 | 79 | 50 | 2 | 33 | 2 | 6 | 3 | 55 | 119 | 71 | 360 |

The following is a table of the measurements and stand on half an acre of compartment E:

| Total Number Trees. | Circumference. | Quercus alba. White oak. | Quercus coccinea. Scarlet oak. | Quercus imbricaria. Shingle oak. | Quercus rubra. Red oak. | Quercus velutina. Black oak. | Carya glabra. Black hickory. | Carya ovata. Shellbark hickory. | Acer rubrum. Red maple. | Betula nigra. Birch. | Nyssa sylvatica. Black gum. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 1. | 2 | ..... | ..... | ..... | 1 | 2 | 2 | ..... | ..... | ..... |
| 2 | 1.1 | 1 | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... | ..... |
| 5 | 1.2 | 1 | ..... | ..... | ..... | ..... | 3 | 1 | ..... | ..... | ..... |
| 5 | 1.3 | ..... | ..... | ..... | ..... | ..... | 4 | ..... | ..... | ..... | 1 |
| 5 | 1.4 | 2 | ..... | ..... | ..... | ..... | 3 | ..... | ..... | ..... | ..... |
| 10 | 1.5 | 2 | ..... | ..... | 1 | ..... | 7 | ..... | ..... | ..... | ..... |
| 3 | 1.6 | 2 | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... | ..... |
| 5 | 1.7 | 1 | ..... | ..... | ..... | ..... | 4 | ..... | ..... | ..... | ..... |
| 19 | 1.8 | 4 | ..... | 1 | 1 | ..... | 11 | 1 | ..... | ..... | 1 |
| 15 | 1.9 | 5 | ..... | 1 | 1 | ..... | 6 | 2 | ..... | ..... | ..... |
| 24 | 2. | 6 | ..... | ..... | ..... | 3 | 10 | 5 | ..... | ..... | ..... |
| 7 | 2.1 | 3 | ..... | ..... | ..... | 1 | 1 | 1 | ..... | ..... | 1 |
| 14 | 2.2 | 4 | 1 | ..... | ..... | 1 | 4 | 3 | ..... | ..... | 1 |
| 10 | 2.3 | 5 | ..... | ..... | ..... | ..... | ..... | 3 | 2 | ..... | ..... |
| 11 | 2.4 | 4 | 1 | ..... | 1 | 1 | 4 | ..... | ..... | ..... | ..... |
| 15 | 2.5 | 5 | ..... | ..... | ..... | ..... | 6 | 2 | ..... | ..... | 2 |
| 13 | 2.6 | 6 | ..... | ..... | ..... | ..... | 2 | 3 | ..... | ..... | 1 |
| 6 | 2.7 | 2 | ..... | ..... | ..... | 2 | ..... | 1 | 1 | ..... | ..... |
| 10 | 2.8 | 5 | ..... | ..... | ..... | ..... | 3 | 1 | ..... | ..... | 1 |
| 11 | 2.9 | 5 | ..... | ..... | ..... | ..... | 4 | 2 | ..... | ..... | ..... |
| 12 | 3. | 8 | ..... | ..... | ..... | ..... | 1 | 3 | ..... | ..... | ..... |
| 7 | 3.1 | 5 | 1 | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... |
| 11 | 3.2 | 5 | ..... | 1 | ..... | ..... | 1 | 4 | ..... | ..... | ..... |
| 9 | 3.3 | 5 | ..... | ..... | ..... | ..... | 1 | 2 | ..... | ..... | 1 |
| 12 | 3.4 | 8 | 1 | ..... | ..... | ..... | 1 | 2 | ..... | ..... | ..... |
| 10 | 3.5 | 5 | 1 | ..... | ..... | 1 | ..... | 2 | 1 | ..... | ..... |
| 5 | 3.6 | 2 | ..... | ..... | ..... | 2 | ..... | 1 | ..... | ..... | ..... |
| 3 | 3.7 | 3 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |



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| Total Number Trees. | Circumference. | Quercus alba. White oak. | Quercus coccinea. Scarlet oak. | Quercus imbricaria. Shingle oak. | Quercus rubra. Red oak. | Quercus velutina. Black oak. | Carya glabra. Black hickory. | Carya ovata. Shellbark hickory. | Acer rubrum. Red maple. | Betula nigra. Birch. | Nyssa sylvatica. Black gum. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 3.8 | 1 | 1 | ..... | ..... | ..... | 1 | 1 | 1 | ..... | 1 |
| 8 | 3.9 | 4 | 1 | ..... | ..... | 1 | ..... | 2 | ..... | ..... | ..... |
| 12 | 4. | 10 | ..... | ..... | ..... | ..... | ..... | 2 | ..... | ..... | ..... |
| 5 | 4.1 | 5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | 4.2 | 4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | 4.3 | 5 | ..... | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... |
| 8 | 4.4 | 6 | ..... | ..... | 1 | ..... | ..... | 1 | ..... | ..... | ..... |
| 4 | 4.5 | 4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 5 | 4.6 | 4 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 5 | 4.7 | 4 | ..... | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... |
| 2 | 4.8 | 1 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | 4.9 | 3 | ..... | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... |
| 10 | 5. | 8 | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | 5.1 | 4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | 5.2 | 2 | 2 | ..... | ..... | ..... | 1 | ..... | ..... | ..... | ..... |
| 2 | 5.3 | 2 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 5.4 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | 5.5 | 6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 5.7 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | 5.8 | 2 | 1 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | 5.9 | 2 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | 6. | 6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | 6.1 | 3 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 6.2 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 6.3 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 8 | 6.4 | 8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | 6.5 | 3 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 6.7 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | 6.8 | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | 6.9 | 1 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | 7. | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 7.3 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 7.4 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 7.5 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | 7.6 | ..... | 1 | ..... | ..... | 1 | ..... | ..... | ..... | ..... | ..... |
| 2 | 8.1 | 1 | ..... | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 8.4 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | 8.6 | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 8.9 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 9.1 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 9.3 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 9.5 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 9.7 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 9.8 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 10.3 | ..... | ..... | ..... | ..... | 1 | ..... | ..... | ..... | ..... | ..... |
| 2 | 10.5 | 2 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 11.5 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 14.4 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 14.7 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 16.7 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | ..... |
| 1 | 17.5 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 18.2 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 19. | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 19.1 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 19.2 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 20.3 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 23. | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 23.6 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 25. | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 27.5 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 29.2 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | 32.6 | 1 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 435 | ..... | 234 | 26 | 4 | 7 | 15 | 82 | 51 | 5 | 1 | 10 |

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## TRACT 59.

This tract was an old field which joins Tract 46 on the west. The area is two and seven-tenths acres and was planted to black locust. There are no records prior to 1909 to show how this tract was managed. On the north part there are about one hundred walnuts which show three years' growth, and it is inferred that seed were planted about four years ago on the tract and that the present stand of walnut is the result of this planting. On the south part are about eight hundred and fifty black locust which show three years' growth. They are planted in rows, and from the irregularity of the stand it appears that this area was planted to utilize a surplus lot of seedlings.

Since the tract contained so many good thrifty trees it was decided to complete the planting with locust to contrast with Tract 46, which was planted at the same time with the same quality of seedlings after the ground was prepared as for corn. The seedlings were planted on the open spaces of the tract 4 x 4 feet by the "rock in" method. The result to date has been quite satisfactory.

The financial statement of the tract to date is as follows:

| | | |
|---|---|---|
| Apr. 16, 1912. | Labor planting trees..... | $4 37 |
| | 3,845 seedlings, 24-inch, at $3 per thousand..... | 11 54 |
| | Total ..... | $15 91 |

## TRACT 60.

This tract contains 1.04 acres and was planted with chestnut oak. The tract is part of a cleared field that had not been farmed for ten years. It had grown up in briers, sassafras, persimmon and hickory. The hickories are coppice shoots, some of which are three inches in diameter. The original forest for the most part was chestnut oak and black oak. The soil is a light clay loam. The surface slopes to the south and is broken by two ravines.

All of the area that was not set with good species was planted. The seedlings were six to twelve inches long and were planted in rows 4x4 feet by the "rock in" method. The seedlings were donated by a nurseryman of Tennessee, who had them dug and could not sell them. It is estimated that they are worth at least $4.00 per 1,000 delivered.

It is estimated that about 40 per cent. lived, and the tract will be reinforced in the spring of 1913.

The financial statement of the tract to date is as follows:

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| | | |
|---|---|---|
| May 8, 1912. | Labor planting trees | $4 50 |
| | 3,000 chestnut seedlings, 6-12 inch, at $4 | 12 00 |
| | Total | $16 50 |

MISCELLANEOUS PLANTING.

It is planned to reinforce each planting until a complete stand is obtained. This spring the vacancies in the following tracts were replanted:

In Tract 25, with an area of 8.83 acres, 5,221 tulip and 577 locust were required. Of the original planting of tulip, 46 per cent. and of the locust 19 per cent. died. The heavy death rate was due to a severe drought which set in immediately after planting and continued for three months.

In Tract 28, containing 9.92 acres, where the hickory failed to grow, the vacancies were planted with nuts, using two in each hill. Ten pounds of nuts were required to do this work.

In Tract 43, out of 2,754 ash seedlings planted only fifteen died, which were replaced.

In Tract 44, containing 3,562 locusts, 1,210 seedlings were required to complete the stand.

In the spring of 1912 the planting of the bank of the ravine, near the tool shed, to black locust was continued and 1,400 were used.

The very steep and denuded bank of the ravine southwest of Tract 37 was also planted with black locust and 1,600 were used. The seedlings planted on the two banks practically all lived.

PROPOSED FIELD PLANTING FOR FALL OF 1912 AND SPRING OF 1913.

The following is a list of the plantings proposed for the fiscal year 1912-1913. The species to be planted have been decided upon, but it may be necessary to make some changes because the species desired may not be obtainable.

Tract 52 is a low, flat, cleared area of .89 acres, which will be planted to cypress if the seedlings can be secured at a reasonable price.

Tract 54 is a cleared field, containing 5.44 acres, which was planted to corn in 1912. The greater part is high ground, which will be planted with nuts of black hickory. The high ground ends in a flat, which will be planted with nuts of the big shellbark hickory.

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Tract 61 is a part of an old field and contains 3.73 acres, which will be planted with seedlings of sycamore. Half of the tract is low and half high ground, which will show the effect, if any, of different soil conditions. One-half of the tract will be planted 4x4 feet and the other half 5x5 feet. The effect of cultivation will be shown by cultivating one-half and not cultivating the other half.

Tract 62 contains 3.1 acres and joins Tract 61. This tract was planted with seed of sycamore in November. A detailed account of this planting is reserved for our next report. The spot method was used and a part was spaced 4x4 feet and a part 5x5 feet. Tracts 61 and 62 are an old field. The west half of these tracts is high ground and the east half is low ground. The two tracts are planted to sycamore to show the adaptation of the species to soil conditions, the two methods of propagation and the effect of spacing and cultivation.

On account of the abundance of timber the sycamore has received little attention and is usually regarded of little value. In recent years its uses have been extended until now it ranks with our leading timbers. In southern Indiana it is especially sought for chair stock. It is now being extensively used for butcher blocks, berry boxes, trunk slats, tobacco boxes and crating, as well as for building material.

Tract 63, with an area of 3.6 acres, was planted late in November with seed of red oak. Half of the tract is high and half low ground, which will give an opportunity to contrast the different soil conditions. A detailed account of this planting will appear in our next report.

Tract 64 is low, wet ground and will be planted with sweet gum.

Tract 65 is a part of a cleared field which is badly eroded and will be planted with ailanthus by the "rock in" method.

Tracts 70, 71, 72 and 73 have a combined area of 8.34 acres. The soil is an upland clay, and all of the tracts have practically the same soil and surface conditions. It is planned to plant these tracts with scrub pine. This species is already well established on these tracts and is one of the most rapidly growing trees on the Reserve One of the tracts will be reinforced with seedlings, a part of which will be planted 4x4 feet and a part 5x5 feet. Another tract will be reinforced with seed by using the seed spot method. Different spacing in planting the seed on this tract also will be tried. Another tract will be plowed and seed will be planted by the seed spot method. The fourth tract will be plowed and planted with seedlings.

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The planting of these for adjoining tracts by different methods and keeping an accurate account of the expense incurred in planting will demonstrate the most economical and profitable method of growing the species.

Tract 75 is a white oak woodland and contains 1.45 acres. The stand on this tract is rather sparse and will average about seven inches in diameter. There is very little small growth on the tract. The stand on this tract is to be completed with black locust to determine whether black locust may be safely used to reinforce a woodlot.

Tract 76 joins Tract 75 and conditions on it are similar. Catalpa will be used to complete the stand to determine if this species may be used to advantage in improving the woodlot. Negative results are expected, but the experiment should be made to show its success or failure.

## A TREE BREEDING EXPERIMENT.

The black locust is possibly the species best adapted for planting on the eroded and sterile hills of the State, but its use is very much circumscribed on account of the ravages of the locust borer. The locust has been planted in small areas in all parts of the State, but only near the Ohio River is it practically free from the borer. Throughout the northern two-thirds of the State no plantation grown from nursery seedlings is known to have reached post size without being seriously injured by the borer. It is conspicuous, however, that volunteer locusts which are the offspring of trees long ago introduced into a locality are much more free from the attack of the borers. This observation has been verified in many parts of the State, and the longer the trees have been introduced the more immune they seem to be. There are notable instances where volunteer trees have not been attacked in badly infested territory. The preceding facts are significant, and the attempt to breed a strain of locust that will in a measure be immune to the attack of the borer appears to be worthy of trial. In view of an experiment to propagate a tree resistant to the borer, it is planned also to combine in the experiment the selection of a tree of a rapid and upright habit of growth.

This fall 200 well developed seed were gathered from each of more than a hundred trees in the different parts of the State. The trees from which seed was gathered were selected with great care. Trees were selected as parents which were about six inches in di-

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ameter, upright in habit of growth and free from borers, or nearly so. The 200 seed of each parent tree will be planted next spring, and it is expected that at least 125 will germinate. The object of planting exactly 200 seed is for the purpose of conducting a germination test in order to credit each parent with the relative vitality of the seed.

In the spring of 1914 the seedlings of each parent to the number of 125 will be planted, and it is expected that 100 will reach an age of 3 to 10 years. At this age the trees will have reached a size sufficient to show their rapidity of growth, their habit of growth, and their power to resist the borer. At approximately the same time, when there is a good crop of seed, one tree from the progeny of each parent tree will be selected to be the parent of the next generation and the work continued as before. The duration of the experiment will be governed by the results.

## FOREST CLEANING.

For want of funds no forest cleaning was done other than that done by the custodian and teamster at times during the winter months when they were not able to do other work. About one hundred and fifty dollars was spent in cleaning and grubbing old fields to prepare them for forest planting and in cleaning the fire lines.

## INSECT DAMAGE.

The blister beetle (Macrobasis unicolor Kirby) appeared in the Kentucky coffee-nut planting on May 27, and before it left it partially defoliated the trees.

This year the larvæ of the catalpa sphinx was noted for the first time on June 3. The date of the first appearance of the second brood was on July 25. The first brood partially defoliated the four tracts of catalpa. The second brood was by far the more destructive and completely defoliated Tracts 33 and 42, except a portion of Tract 33, which was sprayed with arsenate of lead. The greater part of Tract 40 was completely defoliated. Tract 21 was only partially defoliated. Observations were made on both broods to determine what percentage was parasitized, and very few individuals in either brood were found to be parasitized.

An attack of the catalpa sphinx in a catalpa plantation furnishes a difficult problem. To control the larvæ by spraying is too expensive. If a single treatment would end the trouble one would be justified in spraying to rid the plantation of them, but

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when they are likely to invade it more or less each year for a number of years the cost of spraying becomes prohibitive. The most feasible method to control the catalpa sphinx is to keep hogs in the lot from the middle of June to September. The hogs by tramping and rooting destroy many of the larvæ when they fall to the ground and the pupæ in the ground. Chickens also are usually very fond of the larvæ, although some flocks are found that do not care for them. Where it is not convenient to turn hogs into a plantation it is a choice between the expense of spraying or having the trees defoliated, which means a very slow growth. There is a catalpa plantation about one mile north of Sullivan that is about 40 years old, which is annually twice defoliated. As a result the trees on the interior of this plantation will not average over six inches in diameter. The sphinx is now common throughout the southern half of the State, a condition which presents a serious objection to the planting of catalpa in this region. This pest is spreading in the State and plantations that have been free heretofore were attacked this year for the first time.

## FOREST FIRES.

During the past year no fire escaped on the Reserve and at no time was it threatened by an invading fire. The fire lines are kept clean and every precaution is taken to avoid fire.

## GENERAL IMPROVEMENTS.

The administration building is constructed of logs, and the length and size of the logs are such that there is considerable expansion and contraction due to atmospheric conditions, which results in a constant loosening of the chinking between the logs. Last winter because of this the house could not be comfortably heated. It was therefore decided to ceil the rooms on the inside. All of the chinking on both sides was removed and replaced by new. The interior of the house was given two coats of paint and the porches were painted. The building is now in first-class condition, both inside and outside.

The roads through the Reserve are maintained at a cost of about $50.00 per annum. The greatest expense is in maintaining the hill road on account of landslides.

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## RAINFALL ON THE RESERVE.

In order to correlate the growth of the trees with the annual amount of rainfall, a standard rain gauge was established on the Reserve and the daily amount of precipitation is recorded. A tabulated statement of the amount since March 1, 1912, is as follows:

| Day. | March. | Snow. | April. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | ..... | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.08 | 0.9 | 0.59 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 |
| 3 | 0.40 | 3.8 | 0.00 | 0.00 | 0.00 | 0.08 | 0.14 | 0.00 |
| 4 | 0.00 | ..... | 0.00 | 0.09 | 0.00 | 0.17 | 0.00 | 0.00 |
| 5 | 0.00 | ..... | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | ..... | 0.00 | 0.97 | 0.04 | 0.06 | 0.00 | 0.00 |
| 7 | 0.08 | ..... | 0.07 | 0.11 | 0.00 | 0.00 | 0.12 | 0.00 |
| 8 | 0.40 | ..... | 0.00 | 0.07 | 0.00 | 0.00 | 0.10 | 0.00 |
| 9 | 0.05 | 0.8 | 0.00 | 0.05 | 0.00 | 0.00 | 2.59 | 0.00 |
| 10 | 0.00 | ..... | 0.00 | 0.00 | 0.00 | 0.08 | 0.07 | 0.00 |
| 11 | 0.24 | 1.5 | 0.00 | 2.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | 0.14 | ..... | 0.00 | 0.19 | 0.00 | 0.00 | 0.80 | 0.00 |
| 13 | 0.02 | ..... | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | 0.13 | ..... | 0.02 | 0.00 | 0.29 | 0.00 | 0.38 | 0.14 |
| 15 | 0.60 | ..... | T | 0.00 | 0.39 | 0.00 | 0.00 | 0.24 |
| 16 | 0.00 | ..... | 0.00 | 0.42 | 0.16 | 0.09 | 0.00 | 0.84 |
| 17 | 0.00 | ..... | 1.02 | 0.35 | 0.64 | 0.00 | 0.00 | 0.81 |
| 18 | 0.00 | ..... | 0.00 | 0.00 | 0.31 | 0.20 | 0.00 | 0.00 |
| 19 | 0.17 | ..... | 0.00 | 0.00 | 0.02 | 0.00 | 0.37 | 0.00 |
| 20 | 0.17 | ..... | 0.00 | 0.00 | 0.00 | 0.00 | 0.92 | 0.00 |
| 21 | 0.63 | ..... | T | 0.00 | 0.09 | 0.92 | 0.07 | 0.00 |
| 22 | 0.00 | ..... | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 |
| 23 | 0.29 | ..... | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 |
| 24 | 0.94 | ..... | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.02 | ..... | 0.00 | 0.23 | 0.00 | 0.00 | 0.00 | 0.34 |
| 26 | 0.00 | ..... | 1.69 | 0.00 | 0.10 | 0.00 | 0.00 | 0.64 |
| 27 | 0.00 | ..... | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | 0.46 | ..... | 0.02 | 0.43 | 0.24 | 0.00 | 0.00 | 0.00 |
| 29 | 0.24 | ..... | 0.93 | 0.46 | 0.01 | 0.04 | 1.48 | 0.00 |
| 30 | 0.00 | ..... | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | 0.00 | ..... | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sum | 5.06 | 6.19 | 5.75 | 5.75 | 2.29 | 1.64 | 7.34 | 4.11 |

The sum for the seven months is 38.13 inches, which is much in excess of the annual average for the State.

## VISITORS.

The Forest Reserve is located in Clark County, one mile north of Henryville. It may be reached by the Pennsylvania Railroad by going to Henryville. The Indianapolis and Louisville Traction Line touches the Reserve on the east and all local cars will stop at the Reserve station. Every one interested in forestry is invited to visit the Reserve at any time.

A general invitation was extended the public to visit the Reserve on July 25, 1912, and over fifty persons from different parts of the State responded.

During the year 384 persons registered at the Reserve, coming from the following states: Three hundred and forty-five from Indi-

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ana, twenty-six from Kentucky, four from New Mexico, two each from California and Illinois and Pennsylvania, one each from Iowa, Ohio and Oregon.

### RECEIPTS FROM SALES.

The receipts from sales for the fiscal year were as follows:

| | | |
|---|---|---|
| Feb. 5, 1912. | Chas. Guernsey, 27 shocks fodder at 10 cents.... | $2 70 |
| | James Boling, 40 shocks fodder at 10 cents..... | 4 00 |
| June 17, 1912. | Chas. Guernsey, 12 shocks fodder at 10 cents... | 1 20 |
| | Mr. Beswick, 1 bushel corn at $1..... | 1 00 |
| | Jonas Dean, 15 shocks fodder at 10 cents..... | 1 50 |
| | Henry Richardson, 5 shocks fodder at 10 cents.. | 50 |
| Sept. 5, 1912. | Marion Burton, 1 bushel corn at $1..... | 1 00 |
| | Henry Richardson, ½ bushel corn at $1..... | 50 |
| | Total ..... | $12 40 |

## REPORT ON THE PROGRESS OF SOME OF THE FIRST TRACTS PLANTED ON THE RESERVE.

The Reservation is in reality a forest experimental station. From the beginning forest tracts have been planted and managed with the view of determining the species best adapted for forest planting in Indiana. While the age of the tracts is not sufficient to warrant any definite conclusions as to the final results, yet the public may be interested in the progress of some of the oldest tracts.

In determining the progress of a tract the circumference and height of a sufficient number of trees were taken on different parts of the tract to represent the average growth of the whole. On small tracts all or one-half of the trees were measured. On the larger tracts, all of which are irregular in outline, ten rows were measured. The rows were selected so as to represent average conditions of growth, and a permanent record was made of their location. The average circumference and the average height were obtained by combining the measurements of all the trees taken. These averages do not represent the true progress of the tract and are misleading, from the fact that a majority of the trees measured were trees already overtopped by the trees which represent the future stand. The real progress of the tract should deal only with averages of the dominant trees, and all suppressed and intermediate ones should be dropped. The number of trees to be regarded as dominant will depend upon the species and the period of rotation.

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Ordinarily not more than 200 trees of the hardwood group can mature on an acre. The average growth of the tract at successive periods should be obtained by taking the average growth of the number of trees represented at the final cutting.

### TRACT 1. White Ash.

This tract was a cultivated field which was planted with the seed of ash in November, 1904. The ground was prepared as for corn and the seed drilled thickly in rows, which were made about five feet apart. The trees were given a limited cultivation for two years. In the fall of 1906 the rows were thinned, leaving the trees approximately five feet apart in the rows. The trees were given some cultivation for the next four years. In the winter of 1909 all of the tract was pruned, except ten rows which were left to grow natural. The part that was pruned was divided. One part was given a moderate pruning, in which only the lower and larger side branches and terminal forks were removed. The other part was given a severe pruning. The greater number of the trees were pruned to a switch. As a result of the severe pruning many were broken off by a windstorm on May 30, 1910. Those broken off were at once coppiced.

In October, 1912, the circumference and height were taken of all of the trees in the ten rows that were never pruned and in ten consecutive rows each of the parts that were given a severe and moderate pruning. The rows containing the severely pruned trees were much shorter and consequently fewer trees were measured. The soil conditions on the three parts are practically the same. It would be expected that the trees that were not pruned would have the greatest circumference and those that were severely pruned would be the tallest, which is somewhat at variance with the following table.

The stand in the parts not pruned and moderately pruned is practically complete, 5x5 feet, whereas in the part severely pruned the stand is about 60 per cent. a condition due to the storm referred to above. It may be said, however, that the present stand is sufficiently dense. See Plates 2 and 3.

The following table gives the circumference and average height of the trees in the three parts and represents the growth for eight years from the seed:

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PLATE No. 2. Ash in Tract 1, which have received a moderate pruning. The trees are eight years old from the seed and have an average circumference of 2.6 inches and an average height of 134.3 inches.

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PLATE No. 3. Ash in Tract 1, which received a severe pruning. The trees are eight years old from the seed and have an average circumference of 2.9 inches and an average height of 142 inches.

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| Trees Not Pruned. | | | Trees Moderately Pruned. | | | Trees Severely Pruned. | | |
|---|---|---|---|---|---|---|---|---|
| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
| 3 | 1. | 76. | 2 | 1. | 74. | 3 | 1. | 73. |
| 7 | 1.1 | 81.5 | 12 | 1.1 | 75.9 | 2 | 1.1 | 78. |
| 7 | 1.2 | 92.4 | 10 | 1.2 | 82.7 | 3 | 1.2 | 86. |
| 12 | 1.3 | 108. | 12 | 1.3 | 80.5 | 3 | 1.3 | 79. |
| 8 | 1.4 | 105. | 10 | 1.4 | 89.3 | 3 | 1.4 | 91. |
| 11 | 1.5 | 88. | 11 | 1.5 | 98.8 | 1 | 1.5 | 84. |
| 15 | 1.6 | 102.3 | 10 | 1.6 | 104.4 | 3 | 1.6 | 89.5 |
| 9 | 1.7 | 104.5 | 10 | 1.7 | 106.5 | 2 | 1.7 | 107. |
| 12 | 1.8 | 106.8 | 20 | 1.8 | 108.7 | 1 | 1.8 | 112. |
| 13 | 1.9 | 113.9 | 11 | 1.9 | 109.8 | 5 | 1.9 | 107. |
| 28 | 2. | 116.2 | 15 | 2. | 106.7 | 3 | 2. | 111.1 |
| 18 | 2.1 | 121.9 | 13 | 2.1 | 122. | 4 | 2.1 | 101.1 |
| 26 | 2.2 | 125. | 13 | 2.2 | 122.1 | 5 | 2.2 | 109.7 |
| 26 | 2.3 | 132.6 | 18 | 2.3 | 119.5 | 3 | 2.3 | 132.5 |
| 17 | 2.4 | 127.9 | 12 | 2.4 | 127. | 4 | 2.4 | 122.4 |
| 21 | 2.5 | 138.8 | 20 | 2.5 | 117.5 | 10 | 2.5 | 125.3 |
| 30 | 2.6 | 137.6 | 16 | 2.6 | 137.1 | 9 | 2.6 | 134. |
| 24 | 2.7 | 141.6 | 6 | 2.7 | 129.6 | 5 | 2.7 | 157. |
| 22 | 2.8 | 144.6 | 23 | 2.8 | 139.3 | 11 | 2.8 | 138. |
| 25 | 2.9 | 150.8 | 20 | 2.9 | 139.2 | 6 | 2.9 | 141.7 |
| 32 | 3. | 151.6 | 34 | 3. | 177. | 11 | 3. | 146.1 |
| 12 | 3.1 | 152.3 | 20 | 3.1 | 147.4 | 8 | 3.1 | 148.1 |
| 25 | 3.2 | 159.9 | 13 | 3.2 | 145.9 | 9 | 3.2 | 148.4 |
| 10 | 3.3 | 153.4 | 14 | 3.3 | 155.9 | 6 | 3.3 | 151.9 |
| 15 | 3.4 | 164.9 | 12 | 3.4 | 147.5 | 11 | 3.4 | 163.6 |
| 17 | 3.5 | 162.6 | 14 | 3.5 | 162.2 | 14 | 3.5 | 162.5 |
| 12 | 3.6 | 164.2 | 3 | 3.6 | 148.1 | 6 | 3.6 | 172.4 |
| 6 | 3.7 | 168.4 | 5 | 3.7 | 166.6 | 7 | 3.7 | 166.6 |
| 12 | 3.8 | 164.5 | 9 | 3.8 | 162.9 | 10 | 3.8 | 173.2 |
| 13 | 3.9 | 175.2 | 10 | 3.9 | 174.6 | 6 | 3.9 | 165. |
| 14 | 4. | 175.5 | 13 | 4. | 165.8 | 4 | 4. | 175.7 |
| 3 | 4.1 | 179.3 | 7 | 4.1 | 169.3 | 1 | 4.1 | 175.5 |
| 4 | 4.2 | 173. | 3 | 4.2 | 186. | 3 | 4.3 | 189. |
| 5 | 4.3 | 162.6 | 2 | 4.3 | 160.7 | 1 | 4 5 | 175.5 |
| 4 | 4.4 | 173. | 8 | 4.4 | 163. | 1 | 4.6 | 176.5 |
| 7 | 4.5 | 184.9 | 7 | 4.5 | 180.2 | 2 | 4.7 | 193. |
| 4 | 4.6 | 183.1 | 2 | 4.8 | 188.5 | 1 | 4.8 | 192. |
| 2 | 4.7 | 177.2 | 3 | 4.9 | 189. | | | |
| 1 | 4.8 | 172. | 1 | 5.1 | 174. | | | |
| 1 | 4.9 | 193.9 | 1 | 5.2 | 206.5 | | | |
| 1 | 5.2 | 207. | 1 | 5.9 | 208.5 | | | |
| 1 | 5.6 | 202. | | | | | | |
| 1 | 6.4 | 234. | | | | | | |
| 537 | 2.72 | 135.96 | 446 | 2.62 | 134.25 | 187 | 2.93 | 142.01 |

## TRACT 2. Oak.

This tract is a part of an old field and contains 2.38 acres. It was planted in the fall of 1904 with acorns of several species. The greater part of the tract was planted with chestnut oak. The surface is fairly level. The quality of the soil is typical "white oak" land. The ground was prepared for planting as for corn. The acorns were drilled thickly in rows five feet apart. The trees were cultivated more or less for seven years. In the fall of 1906 the trees in the rows were thinned, leaving them approximately five feet apart. In the spring of 1908 the vacant places of the tract were planted with seedlings of tulip, which are now equal in height to the oak. In the spring of 1910 the tract was given a moderate

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pruning. In January of 1911 the tract was gone over and forked terminals were corrected and 214 defective trees were coppiced.

In the fall of 1907 the trees on one-half acre, all of which are chestnut oak, were counted and their height measured. (See report for 1907, page 88.) In October of 1912 the circumference and height of all the oak trees on the same half acre were again measured, which are given in the following table:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|---|---|---|
| 116 | ..... | 59.9 | 8 | 2.3 | 115.2 | 3 | 3.7 | 152.3 |
| 13 | 1. | 75.5 | 10 | 2.4 | 119.7 | 5 | 3.8 | 144.1 |
| 8 | 1.1 | 78.5 | 15 | 2.5 | 121.5 | 5 | 3.9 | 155. |
| 13 | 1.2 | 80.2 | 15 | 2.6 | 121.4 | 5 | 4. | 161.7 |
| 18 | 1.3 | 88. | 9 | 2.7 | 126.4 | 2 | 4.1 | 165.5 |
| 15 | 1.4 | 94.6 | 12 | 2.8 | 131.3 | 2 | 4.2 | 170.5 |
| 15 | 1.5 | 95.4 | 7 | 2.9 | 125.6 | 2 | 4.3 | 175. |
| 17 | 1.6 | 91.6 | 11 | 3. | 137.9 | 1 | 4.4 | 176.5 |
| 14 | 1.7 | 100. | 16 | 3.1 | 138.8 | 1 | 4.6 | 172. |
| 12 | 1.8 | 105.8 | 10 | 3.2 | 142.5 | 1 | 5. | 184.5 |
| 16 | 1.9 | 104.9 | 9 | 3.3 | 136.8 | | | |
| 23 | 2. | 108.8 | 7 | 3.4 | 148.1 | | | |
| 14 | 2.1 | 112.2 | 8 | 3.5 | 147.9 | | | |
| 16 | 2.2 | 110.4 | 7 | 3.6 | 160.7 | | | |

Total number of trees, 484. Total number of trees in 1907 was 418.
Average circumference of trees one inch and more in circumference, 2.3 inches.
Average height of total number of trees, 96.9 inches.
Average height of the total number of trees in 1907 was 19.1 inches.

## TRACT 16. Black Walnut.

This tract was a cleared field and contains 5.64 acres. It is located at the base of the "knobs" and is practically surrounded by woods. The surface is gently rolling, with good surface drainage, except the southeast corner. The soil is a clay loam. The tract was planted in the spring of 1904 with seed of black walnut in rows at distances of five feet apart each way. (See Plate 4.) It received two plowings each season for the first five years and one plowing each year for the next two years. In the spring of 1910 the total number of walnut trees on the tract was 6,136. On March 2d of the same year the trees were pruned. All trees that showed an upright growth were given a moderate pruning. All that were one and one-half inches in diameter at the base and had a bushy top were coppiced; these numbered 328. In the fall the coppiced stumps were observed and it was found that 247 of the stumps had sent out coppice shoots. On March 9, 1911, the tract was again gone over and the bushy-topped trees, to the number of 1,248, were coppiced. An examination of the stumps in the fall of 1912 showed that 1,217 have sent out coppice shoots. The purpose in coppicing is to obtain

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PLATE No. 4. Black Walnut in Tract 16. The trees are nine years old from the seed and have an average circumference of 2.1 inches and an average height of 69.4 inches.

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straight trees; however, this result was not secured in this tract. A count was made of the 247 coppice shoots which are 3 years old to determine how many have continued to grow an erect terminal and it was found that 129 trees have an upright terminal. The 1,217 coppice shoots which are 2 years old were also examined and it was found that 786 have grown an upright terminal this season. While these figures are somewhat discouraging, it is believed that the benefits will justify the expense. In connection with this work a study is being made of the relation of the quality of the soil to the branching of the terminal of this species.

In order to ascertain the growth of the trees on this tract, in October, 1912, the height and circumference breast-high of all the trees in every tenth row were measured. The rows measured were determined by using the row near the center, which contains a large native walnut as a base line, and from this row on both sides every tenth row was measured.

The following is a tabulated statement of the measurements taken:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|
| 257 | ..... | 39.9 | 5 | 2.9 | 120.7 |
| 15 | 1. | 64.9 | 9 | 3. | 119.2 |
| 21 | 1.1 | 68.6 | 8 | 3.1 | 117.9 |
| 19 | 1.2 | 73. | 5 | 3.2 | 119.6 |
| 14 | 1.3 | 74. | 4 | 3.3 | 122. |
| 16 | 1.4 | 81.4 | 4 | 3.4 | 130.3 |
| 14 | 1.5 | 80.3 | 6 | 3.5 | 124.6 |
| 13 | 1.6 | 88.1 | 5 | 3.6 | 119.7 |
| 13 | 1.7 | 85.2 | 4 | 3.7 | 117.3 |
| 19 | 1.8 | 86.7 | 4 | 3.8 | 139.5 |
| 7 | 1.9 | 93.2 | 1 | 3.9 | 125. |
| 18 | 2. | 93.1 | 4 | 4. | 139.9 |
| 12 | 2.1 | 95. | 2 | 4.1 | 130.3 |
| 11 | 2.2 | 95.6 | 1 | 4.2 | 151. |
| 5 | 2.3 | 98. | 1 | 4.3 | 159. |
| 3 | 2.4 | 110. | 4 | 4.5 | 149.6 |
| 10 | 2.5 | 102.8 | 1 | 4.6 | 135. |
| 4 | 2.6 | 110.2 | 1 | 4.8 | 153.5 |
| 6 | 2.7 | 102.7 | 1 | 4.9 | 154. |
| 5 | 2.8 | 114.8 | | | |

Total number of trees, 552.
Average circumference of trees one inch and more in circumference, 2.1 inches.
Average height of total number of trees, 69.4 inches.

## TRACT 26. Tulip.

This tract is a part of a cleared field and contains 1.71 acres. The surface is very gently rolling, but broken by a deep erosion ditch which crosses it from east to west. The soil is a clay loam. (See Plates 5 and 6.)



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PLATE No. 5. Tulip or Yellow Poplar in Tract 26, which have never been pruned. The trees are seven years old from the seed.

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PLATE No. 6. Tulip or Yellow Poplar in Tract 26, which have received a moderate pruning. The trees are seven years old from the seed.

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One-year-old seedlings of tulip were planted in the spring of 1907. The planting was done by plowing furrows approximately five feet apart, into which the seedlings were dropped approximately five feet apart. Then a furrow was plowed on the roots and workmen followed and straightened the trees up and firmed them in the ground with the foot. The trees were plowed and hoed twice in 1909 and three times in 1910. All of the tract, except ten rows on the west side, was given a moderate pruning in January of 1910 and 1911. During the winter of 1911-1912 many of the trees were so badly damaged by "winter killing" that it was necessary to coppice 432 out of a total of 1,774 trees. The bark on the body of the trees on the southwest side was killed by desiccation during the continued cold weather.

In October, 1912, the average height and circumference of the stand was taken by measuring every fifth row the long way of the tract, beginning with the sixth row from the west side and continuing until five rows were measured. The following is a tabulated statement of the work:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|
| 48 | ..... | 57.1 | 10 | 3.4 | 146.3 |
| 7 | 1. | 79.6 | 8 | 3.5 | 150.9 |
| 4 | 1.1 | 91.6 | 5 | 3.6 | 148.6 |
| 11 | 1.2 | 85.9 | 3 | 3.7 | 158.1 |
| 4 | 1.3 | 92. | 4 | 3.8 | 154.1 |
| 3 | 1.4 | 84.1 | 5 | 3.9 | 175.8 |
| 9 | 1.5 | 94.8 | 7 | 4. | 166.1 |
| 5 | 1.6 | 107.5 | 6 | 4.1 | 170.9 |
| 7 | 1.7 | 104.2 | 3 | 4.2 | 174.8 |
| 5 | 1.8 | 109. | 7 | 4.3 | 164.9 |
| 9 | 1.9 | 115. | 4 | 4.4 | 169.6 |
| 6 | 2. | 112. | 6 | 4.5 | 180.8 |
| 3 | 2.1 | 112.5 | 3 | 4.6 | 167. |
| 8 | 2.2 | 122.9 | 2 | 4.7 | 177.5 |
| 10 | 2.3 | 121.6 | 5 | 4.8 | 186.5 |
| 4 | 2.4 | 128.8 | 1 | 4.9 | 174. |
| 12 | 2.5 | 129.4 | 3 | 5. | 189.3 |
| 8 | 2.6 | 126.1 | 3 | 5.1 | 185.8 |
| 5 | 2.7 | 124.4 | 1 | 5.2 | 192.5 |
| 7 | 2.8 | 137. | 2 | 5.3 | 175.3 |
| 2 | 2.9 | 149. | 3 | 5.4 | 195.5 |
| 6 | 3. | 147.3 | 1 | 5.5 | 192. |
| 8 | 3.1 | 138.2 | 2 | 5.6 | 194.5 |
| 10 | 3.2 | 145. | 1 | 5.7 | 194.5 |
| 7 | 3.3 | 148.9 | | | |

Total number of trees, 303.
Average circumference of trees one inch and over in circumference, 2.9 inches.
Average height of total number of trees, 124.6 inches.

## TRACT 29. Chestnut.

The surface is nearly level, with natural drainage to the south. The soil is a clay loam. The tract is a part of a cleared field and contains .1 of an acre. It is divided by Tract No. 30, which is thirty-two feet wide. (See Plate 7.) American chestnut seed was

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PLATE No. 7. Chestnut in Tract 29. The trees are eight years old from the seed and have an average circumference of 1.7 inches and an average height of 88.1 inches.

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planted in the fall of 1904 and the seedlings were removed from the nursery to the present location in the spring of 1906. The trees were plowed and hoed each year for six years. In January, 1911, they were given a moderate pruning. In June of the same year a blight attacked the trees and a few were entirely killed. The ends of one or more branches of many more were killed. The blight suddenly ceased and has not caused further damage. Many of the leaves of the trees have been attacked for the past three years by aphids.

In October, 1912, the height and circumference of the trees west of Tract No. 30 were taken. This includes more than half of the tract. The measurements are as follows:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|
| 50 | ..... | 62.5 | 3 | 2. | 107.3 |
| 7 | 1. | 78.5 | 3 | 2.1 | 116.1 |
| 8 | 1.1 | 85.2 | 1 | 2.2 | 120.5 |
| 2 | 1.2 | 89.5 | 2 | 2.3 | 135.2 |
| 7 | 1.3 | 92.8 | 1 | 2.4 | 123.5 |
| 10 | 1.4 | 97.7 | 2 | 2.5 | 134.7 |
| 7 | 1.5 | 100.7 | 1 | 2.6 | 125.5 |
| 5 | 1.6 | 98.3 | 4 | 2.8 | 139.9 |
| 2 | 1.7 | 94.5 | 1 | 2.9 | 135.5 |
| 4 | 1.8 | 111.1 | 1 | 3. | 139.5 |
| 5 | 1.9 | 111.2 | 1 | 3.1 | 144. |
| | | | 1 | 4.8 | 169. |

Total number of trees, 128.
Average circumference of trees one inch or more in circumference, 1.7 inches.
Average height of total number of trees, 88.1 inches.

## TRACT 30. Pecan.

This tract, which contains .07 acre divides Tract 29, and the same soil and surface conditions obtain. (See Plate 8.)

The seed of pecan, obtained from Texas, were planted in the fall of 1904. The seedlings resulting from this planting were transplanted to the present location in the fall of 1906. The trees are spaced 4x4 feet, and were cultivated for five years. In the spring of 1910 the trees were given a severe pruning, many being pruned to a switch. In the spring of 1911 they were given a moderate pruning. In September the tract was defoliated by the larvæ of a species of Datana. Every winter the ends of a few branches of some of the trees are winter killed. In the winter of 1909 a few trees suffered severely. As the trees grow older the damage appears to be less.

In October of 1912 the circumference breast-high and the height of the trees were taken. The measurements are as follows:

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PLATE No. 8. Pecan in Tract 30. The trees are eight years old from the seed and have an average circumference of 1.7 inches and an average height of 68.5 inches.

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| Number Trees. | Circumference. | Average Height. |
|---|---|---|
| 40 | ... | 51.3 |
| 1 | 1. | 67.5 |
| 4 | 1.1 | 67.2 |
| 7 | 1.2 | 67.8 |
| 6 | 1.3 | 72.5 |
| 2 | 1.4 | 80.5 |
| 5 | 1.5 | 82.9 |
| 5 | 1.6 | 81.5 |
| 2 | 1.7 | 83.5 |
| 3 | 1.8 | 87.8 |
| 2 | 1.9 | 92.3 |
| 1 | 2. | 97. |
| 3 | 2.1 | 96.8 |
| 1 | 2.2 | 107. |
| 2 | 2.3 | 103.7 |
| 2 | 2.4 | 88. |
| 1 | 2.5 | 101. |
| 1 | 2.7 | 112.5 |
| 1 | 3.8 | 105. |

Total number of trees, 89.
Average circumference of trees one inch and over in circumference, 1.7 in.
Average height of total number of trees, 68.5 inches.

### TRACT 31. Coffeenut.

This tract was a part of a cleared field with the surface gradually sloping to the south. The area is .6 of an acre. The soil is an upland clay. The tract was originally forested with white oak.

In the fall of 1906 the tract was planted with seedlings of coffeenut which were grown upon the reservation. The trees are spaced approximately 4x5 feet. The planting resulted in about a half of a stand, which was completed in the spring of 1908 with tulip. The trees were cultivated for six years. In July of each year, for at least the past three seasons, the trees have been partially defoliated by the blister beetle (Macrobasis unicolor Kirby).

In October of 1912 the circumference breast-high and the height of three of the eleven rows of trees were measured, with the following results:

| Number Trees. | Circumference. | Average Height. |
|---|---|---|
| 216 | .. | 31.4 |
| 1 | 1. | 60. |
| 1 | 1.2 | 61. |
| 1 | 1.3 | 71. |
| 2 | 1.5 | 74. |
| 2 | 1.6 | 77.7 |

Total number of trees, 223.
Average circumference of trees one inch and more in circumference, 1.4 in.
Average height of total number of trees, 32.7 inches.

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## TRACT 32. Black Locust.

The area of this tract, which was a part of a cleared field, is .52 of an acre. The soil and surface conditions are the same as those of Tract 31, which it joins on the west. (See Plate 9.)

In the fall of 1904 the ground was prepared as for corn, and black locust seed was drilled thickly in rows approximately four feet apart. In the fall of 1906 the seedlings were dug, leaving one at intervals of approximately four feet, which constitutes the present stand. The trees were cultivated for three years. The tract is divided by the wagon road. In February, 1910, the trees south of the road were given a moderate pruning and the trees north of the road were not pruned. The locust borer first appeared during the season of 1910 and practically all of the largest trees were attacked. In 1911-1912 the damage was of little consequence. It is believed that the greater part of the trees are now too large to be seriously injured.

In October, 1912, the circumference breast-high and the height of two of the four rows on the north side of the road and three rows of the twenty rows on the south side of the road were measured. A tabulated statement is as follows:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 93. | 1 | 3.6 | 186. | 1 | 5.9 | 227. |
| 7 | 1.4 | 106.3 | 4 | 3.7 | 206.1 | 2 | 6.1 | 245.5 |
| 1 | 1.5 | 138. | 3 | 3.8 | 193.3 | 1 | 6.2 | 263. |
| 1 | 1.6 | 135. | 7 | 3.9 | 203.3 | 3 | 6.3 | 257.7 |
| 3 | 1.7 | 105. | 5 | 4. | 189.4 | 4 | 6.4 | 253.7 |
| 4 | 1.8 | 117.7 | 5 | 4.1 | 205. | 3 | 6.5 | 253.3 |
| 4 | 1.9 | 129.5 | 4 | 4.2 | 205.2 | 1 | 6.6 | 258. |
| 12 | 2. | 121.3 | 7 | 4.3 | 206.9 | 2 | 6.7 | 246. |
| 4 | 2.1 | 140.5 | 5 | 4.4 | 202.1 | 3 | 7.2 | 258.7 |
| 6 | 2.2 | 138. | 8 | 4.5 | 212.8 | 1 | 7.3 | 250. |
| 5 | 2.3 | 155.6 | 3 | 4.6 | 208.3 | 1 | 7.4 | 255. |
| 4 | 2.4 | 138. | 1 | 4.7 | 236. | 3 | 7.5 | 272. |
| 3 | 2.5 | 159.5 | 4 | 4.8 | 225. | 2 | 7.7 | 262.5 |
| 5 | 2.6 | 154. | 5 | 4.9 | 222.2 | 1 | 7.8 | 264. |
| 3 | 2.7 | 170. | 5 | 5. | 223. | 1 | 7.9 | 285. |
| 3 | 2.8 | 170.6 | 4 | 5.1 | 237.7 | 1 | 8. | 266. |
| 4 | 2.9 | 163.5 | 2 | 5.2 | 250. | 1 | 8.4 | 263. |
| 9 | 3. | 177.7 | 2 | 5.3 | 250.5 | 2 | 8.5 | 282.5 |
| 5 | 3.1 | 174.8 | 3 | 5.4 | 241.3 | 1 | 8.6 | 279. |
| 9 | 3.2 | 176.8 | 1 | 5.5 | 225. | 1 | 9. | 249. |
| 3 | 3.3 | 176. | 8 | 5.6 | 241. | 2 | 9.4 | 275. |
| 2 | 3.4 | 221. | 3 | 5.7 | 236.3 | 2 | 9.9 | 303.5 |
| 5 | 3.5 | 204.8 | 2 | 5.8 | 247. | 1 | 10.8 | 320. |

Total number of trees, 235.
Average circumference, 7.7 inches.
Average height, 196.2 inches.

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PLATE No. 9. Black Locust in Tract 32, which have been moderately pruned. The trees are eight years old from the seed and have an average circumference of 7.7 inches and an average height of 196.2 inches.

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## TRACT 35. Green Ash.

This tract was a cleared field and is entirely surrounded by woods. Its area is 5.16 acres. The surface is fairly level, gradually sloping to the southeast The soil of the greater part of the tract is a compact clay. The southeast part is a sandy loam. The tract was originally forested, principally with white, scarlet and black oaks.

In the spring of 1909 1-year-old seedlings of ash were planted. The seedlings were bought for white ash, but when they leafed out it was found that they are practically all green ash. The seedlings were planted by plowing furrows approximately seven feet apart, dropping the seedlings in the furrows at intervals of approximately six feet and plowing another furrow on the roots. The trees were straightened up by workmen who followed and firmed in the ground with the foot. At least 95 per cent. of the seedlings lived. The tract received one plowing and hoeing in 1909, which was given too late to do much good. In 1910 and 1911 it received four plowings and hoeings each year. There was no cultivation in 1912. The tract has never been pruned.

In October, 1912, the circumference and height of ten rows were measured. The rows measured were the fifth from the south and then every eighth row to the north until ten rows were measured. The results are recorded as follows:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|
| 114 | ..... | 55.7 | 13 | 2. | 119.5 |
| 17 | 1. | 83.8 | 11 | 2.1 | 116.8 |
| 14 | 1.1 | 88. | 7 | 2.2 | 120.3 |
| 16 | 1.2 | 87. | 8 | 2.3 | 128.2 |
| 23 | 1.3 | 93.3 | 8 | 2.4 | 125. |
| 25 | 1.4 | 97.7 | 6 | 2.5 | 124. |
| 25 | 1.5 | 100.4 | 1 | 2.6 | 119. |
| 29 | 1.6 | 102.2 | 2 | 2.7 | 141.5 |
| 22 | 1.7 | 105.6 | 1 | 2.8 | 146. |
| 24 | 1.8 | 104.4 | 3 | 3. | 146.2 |
| 18 | 1.9 | 121.3 | | | |

Total number of trees, 387.
Average circumference of trees one inch and more in circumference, 1.7 inches.
Average height of total number of trees, 90.3 inches.

## TRACT 36. Ash.

This tract was a cleared field and is bounded on three sides by woods. The area is 4.11 acres. The surface is rolling, with a northeast aspect. The soil is a poor clay. The west side is the former site of an old house and garden, and the trees on this part are more

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PLATE No. 10. Ash in Tract 36. The area on which these trees are growing was formerly the site of an old dwelling. They are larger than the average for the tract.

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than twice as large as the average for the tract, which shows the value of a richer soil. (See Plate 10.)' The principal trees of the original forest were white, scarlet and black oaks.

In the spring of 1908 1-year-old seedlings of ash were planted. The stock was purchased for white ash, but practically all of the trees have proven to be green ash. The trees were planted by plowing furrows approximately five feet apart, dropping the seedlings in the furrows at intervals of five feet and plowing a furrow on the roots. Workmen followed who straightened the trees up and firmed them in the ground with the foot. This tract was cultivated for three years. In January, 1911, it was given a moderate pruning.

In October, 1912, the circumference and height of ten average rows were measured. The measurements are tabulated in the following table:

| Number Trees. | Circumference. | Average Height. | Number Trees. | Circumference. | Average Height. |
|---|---|---|---|---|---|
| 99 | ..... | 59.3 | 8 | 3.1 | 138.3 |
| 12 | 1. | 76. | 13 | 3.2 | 141.6 |
| 15 | 1.1 | 78. | 15 | 3.3 | 148. |
| 12 | 1.2 | 82. | 8 | 3.4 | 152. |
| 21 | 1.3 | 79. | 10 | 3.5 | 150.4 |
| 18 | 1.4 | 89.2 | 7 | 3.6 | 151.7 |
| 22 | 1.5 | 92.3 | 8 | 3.7 | 157.1 |
| 22 | 1.6 | 83. | 10 | 3.8 | 152.5 |
| 14 | 1.7 | 98.1 | 2 | 3.9 | 151.2 |
| 20 | 1.8 | 104.7 | 7 | 4. | 164.2 |
| 29 | 1.9 | 103.8 | 1 | 4.1 | 191. |
| 17 | 2. | 106.2 | 1 | 4.2 | 162.5 |
| 17 | 2.1 | 111.3 | 2 | 4.3 | 167.5 |
| 23 | 2.2 | 114.5 | 3 | 4.4 | 186.3 |
| 22 | 2.3 | 124.8 | 2 | 4.6 | 196. |
| 17 | 2.4 | 122.9 | 2 | 4.7 | 190.5 |
| 36 | 2.5 | 122.7 | 2 | 4.9 | 206.5 |
| 19 | 2.6 | 129.1 | 2 | 5. | 190.5 |
| 12 | 2.7 | 128.1 | 2 | 5.1 | 199. |
| 25 | 2.8 | 134.9 | 1 | 5.3 | 208. |
| 15 | 2.9 | 139.2 | 1 | 5.4 | 196. |
| 19 | 3. | 137.5 | 1 | 5.5 | 217. |

Total number trees, 614.
Average circumference of trees one inch and more in circumference, 2.3 inches.
Average height of total number of trees, 107.8 inches.

## TRACT 37. Ash and Elm.

This tract was a cleared field and contains 6.22 acres. It is low and flat, being located between two creeks, which unite on the south border. The soil is a clay, locally known as "crayfish" land.

It was planted in the spring of 1908 with 1-year-old seedlings of ash and white elm, in alternate rows. The seedlings were planted in rows approximately five feet apart and spaced approximately five feet apart in the rows. They were planted by making a hole in the ground with a "V"-shaped spud. The seedling was inserted

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into the hole and firmed in by crowding earth into the hole with the spud and the foot. The stand resulting from this planting was about 90 per cent. for the ash and 40 per cent. for the elm. The tract was cultivated for four years and pruned in February, 1911.

The growth of the trees in this tract was slight until the past two years. They appeared as if stunted. This condition is attributed to the manner in which the trees were planted. It is believed that the roots were not able to penetrate the walls of the hole made with the spud. It should be noted that the ash in this tract was a part of the same lot and planted at the same time as the ash of Tract 36. The soil on this tract is moister, and conditions would apparently favor the more rapid growth of this species.

In October, 1912, the circumference and height of five average rows of each species were measured. The results are shown in the following table:

| Number Trees. | | Circumference. | Average Height. | | Number Trees. | | Circumference. | Average Height. | |
|---|---|---|---|---|---|---|---|---|---|
| Ash. | Elm. | | Ash. | Elm. | Ash. | Elm. | | Ash. | Elm. |
| 56 | 190 | ..... | 62.6 | 58.8 | 10 | ..... | 2.6 | 120.4 | ..... |
| 13 | 6 | 1. | 78.6 | 94.9 | 5 | 1 | 2.7 | 124.3 | 113. |
| 19 | 17 | 1.1 | 80.3 | 92.9 | 8 | 2 | 2.8 | 125.5 | 128. |
| 19 | 7 | 1.2 | 84.2 | 97.1 | 6 | 2 | 2.9 | 125.6 | 124.5 |
| 17 | 3 | 1.3 | 85.5 | 103. | 9 | 1 | 3. | 131.2 | 137.5 |
| 18 | 5 | 1.4 | 88.4 | 104.4 | 4 | ..... | 3.1 | 121.2 | ..... |
| 37 | 6 | 1.5 | 92. | 101.4 | 2 | ..... | 3.2 | 135.7 | ..... |
| 16 | 3 | 1.6 | 95.8 | 105.6 | 7 | 2 | 3.3 | 131.9 | 150.5 |
| 27 | 3 | 1.7 | 98.7 | 111.6 | 3 | ..... | 3.4 | 138.3 | ..... |
| 23 | 3 | 1.8 | 100.4 | 116. | ..... | 1 | 3.5 | ..... | 149. |
| 17 | 2 | 1.9 | 103.7 | 120.7 | 1 | ..... | 3.6 | 146.5 | ..... |
| 14 | 2 | 2. | 103.5 | 123.3 | 1 | ..... | 3.9 | 141. | ..... |
| 10 | 2 | 2.1 | 106.3 | 119.7 | 1 | ..... | 4. | 147. | ..... |
| 11 | 2 | 2.2 | 112.9 | 125.7 | 2 | 2 | 4.1 | 145. | 159.3 |
| 11 | ..... | 2.3 | 106.4 | ..... | ..... | 1 | 4.3 | ..... | 171. |
| 3 | 4 | 2.4 | 109.6 | 129.1 | 1 | ..... | 4.5 | 166. | ..... |
| 12 | 3 | 2.5 | 117. | 144.8 | 1 | ..... | 4.6 | 161. | ..... |
| | | | | | 1 | ..... | 5.1 | 163. | ..... |
| | | | | | 1 | ..... | 5.6 | 183. | ..... |

Total number trees, Ash, 386; Elm, 270.
Average circumference of Ash one inch and over in circumference, 1.9 inches.
Average circumference of Elm one inch and over in circumference, 1.8 inches.
Average height of Ash, 96.6 inches. Average height of Elm, 74.4 inches.

## TRACT 42. Catalpa.

This tract lies just north of Tract No. 2 and was a part of the same cleared field. It contains 1.02 acres. The surface has a northeast exposure. The soil is a clay loam with good drainage.

One-year-old seedlings of catalpa were planted in the fall of 1908 in rows 5x5 feet. The trees were not cultivated in 1909. During the season of 1910 the tract was given four cultivations and in 1911 three. In January, 1911, the trees were given a moderate pruning.

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The catalpa sphinx attacked the tract this year for the first time. The first brood was first noted on June 3, which partially defoliated only a few trees. The second brood was noted for the first time on July 25, and this brood completely defoliated every tree.

In October, 1912, the circumference and height of the trees in ten average rows were taken, with the following results:

| Number Trees. | Circumference. | Average Height. |
|---|---|---|
| 56 | .. | 53.4 |
| 5 | 1. | 66.6 |
| 10 | 1.1 | 68. |
| 4 | 1.2 | 70.2 |
| 10 | 1.3 | 76.2 |
| 8 | 1.4 | 72.4 |
| 9 | 1.5 | 83.1 |
| 8 | 1.6 | 76. |
| 5 | 1.7 | 79. |
| 16 | 1.8 | 83.5 |
| 16 | 1.9 | 83.6 |
| 8 | 2. | 82.7 |
| 28 | 2.1 | 89.9 |
| 28 | 2.2 | 91.6 |
| 15 | 2.3 | 95.8 |
| 16 | 2.4 | 94.2 |
| 14 | 2.5 | 101.9 |
| 13 | 2.6 | 102.5 |
| 10 | 2.7 | 103. |
| 14 | 2.8 | 106.9 |
| 11 | 2.9 | 104.9 |
| 11 | 3. | 109.8 |
| 4 | 3.1 | 112.1 |
| 5 | 3.2 | 123.8 |
| 3 | 3.3 | 116. |
| 1 | 3.5 | 108. |
| 1 | 3.8 | 127. |

Total number of trees, 329.
Average circumference of trees 1 inch and more in circumference, 2.2 inches.
Average height of total number of trees, 85.2 inches.

## CREEK BANK PLANTING.

Near the center of the Reserve a small creek courses through the fields. The east bank, near the tool shed, is about twenty feet high and was badly eroded and washed. In the spring of 1910 a stretch of the bank for a distance of about 200 feet was planted with 2-year-old seedlings of black locust. The north half of the bank is a "soapstone" shale and the south half is a hard clay. The ground was so hard that no vegetation was growing on it, and it was necessary to

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use a mattock to make holes for planting the trees. The south half of the bank was so steep and was washing so rapidly that it was necessary to put some obstruction on the slopes to prevent the trees from washing out. Some pieces of old rails and boards, which were scattered on the top of the bank, were collected and used for this purpose. The summer following the planting was very dry, but only a very few of the 380 seedlings died. Plates 11, 12, 13 and 14 show a part of the bank before treatment and three years after being planted. In the spring of 1912 the planting of the bank was continued and 1,400 1-year-old seedlings of the black locust were used. The season was favorable and practically all lived.

In making a study of the rate growth of the species measured, only the broadest conclusions should be made from the preceding measurements. It should be borne in mind that the tracts were not planted with any idea of comparison; that the soil varies much in the several tracts; and that no two tracts have been managed in exactly the same manner.

It may be said, however, that for the past three years, so far as possible, when a species is planted it is planned so that a comparison may be made of the different methods of planting, spacing, cultivating and pruning.

The following table shows a list of the species, the age from the time the seed was planted, the average circumference and the average height of the trees in the tracts measured:

| Species. | Tract No. | Age. | Average Circumference. (Inches.) | Average Height (Inches.) |
|---|---|---|---|---|
| Ash | 35 | 5 | 1.7 | 90.3 |
| Ash | 37 | 6 | 1.9 | 96.6 |
| Ash | 36 | 6 | 2.3 | 107.8 |
| *Ash | 1 | 8 | 2.6 | 134.3 |
| †Ash | 1 | 8 | 2.7 | 136. |
| ‡Ash | 1 | 8 | 2.9 | 142. |
| Catalpa | 42 | 5 | 2.2 | 85.2 |
| Chestnut | 29 | 8 | 1.7 | 88.1 |
| Coffeenut | 31 | 8 | 1.7 | 68.5 |
| Elm | 37 | 6 | 1.8 | 74.4 |
| Locust | 32 | 8 | 7.7 | 196.2 |
| Oak (Chestnut) | 2 | 8 | 2.3 | 96.9 |
| Pecan | 30 | 8 | 1.7 | 68.5 |
| Tulip | 26 | 7 | 2.9 | 124.6 |
| Walnut | 16 | 9 | 2.1 | 69.4 |

*Moderately pruned. †Not pruned. ‡Severely pruned.

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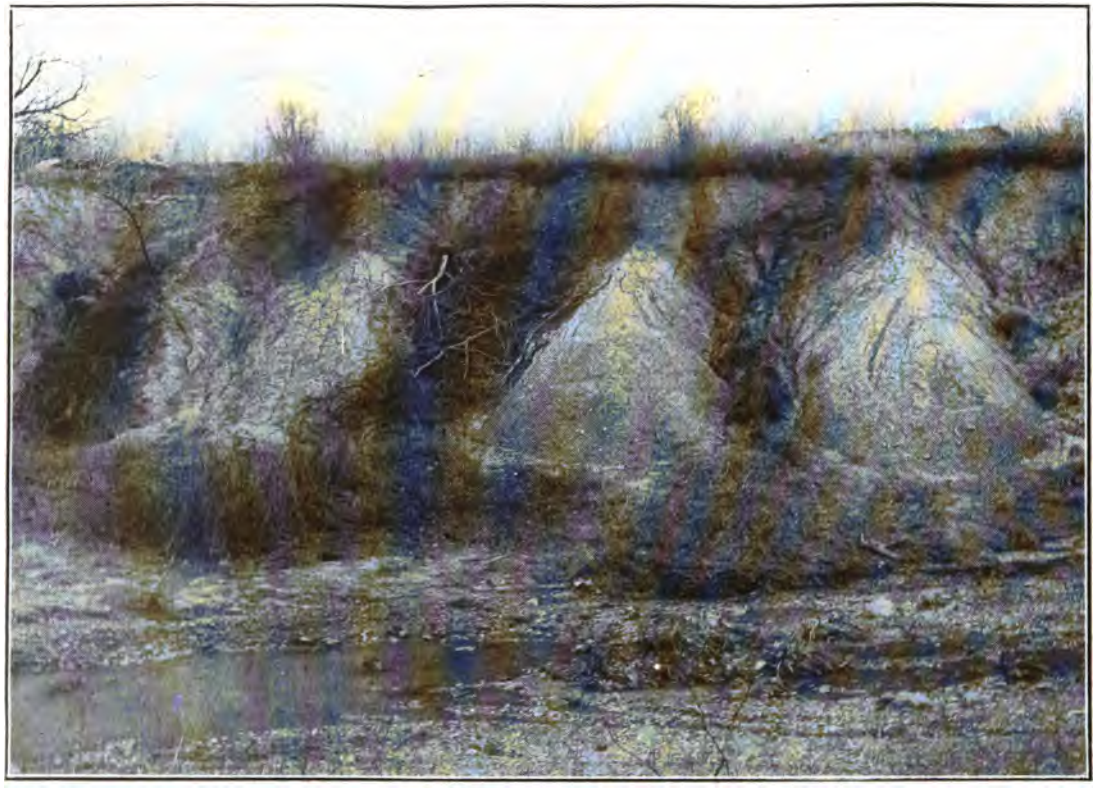

PLATE No. 11. A part of an eroded creek bank on the Forest Reserve, which was planted with seedlings of Black Locust in the spring of 1910.

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PLATE No. 12. A part of the bank shown in Plate No. 11. after being planted three years with Black Locust.

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PLATE No. 13. A part of the bank shown in Plate No. 11, after being planted three years with Black Locust.

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PLATE No. 14. A part of the bank shown in Plate No. 11, after being planted three years with Black Locust.

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# Office Work.

The office force consists of the secretary and stenographer. For convenience of consideration the work done will be reviewed under the following heads:

*Correspondence.*—The correspondence for this year shows a decided increase over that of previous years. During the year 1,200 first-class letters were received and 1,664 first-class letters were mailed. There were also 253 first-class circular letters and 5,601 second-class circular letters mailed.

The correspondence consists principally of inquiries concerning forest planting and management and of requests for annual reports.

*Reports.*—During the year the number of annual reports that have been distributed are as follows: One 1901, 1 1902, 156 1903, 1 1905, 3 1906, 5 1907, 2 1908, 85 1909, 673 1910, and 5,227 1911, making a total of 6,154, an increase of 3,622 over last year. There were also 498 shade tree bulletins distributed.

As the reports of the board are sent out only upon application, the above statement indicates in some measure the increasing interest in forestry. The 1911 report was designed to encourage the teaching of forestry in the public schools, and it is gratifying to find that teachers throughout the State are supplying their pupils with this report and expect to make forestry a special subject of study the coming year.

*Library.*—The necessity of possessing the literature on the subject of forestry is recognized, and an effort is made to acquire all books, bulletins and circulars that are published in the United States on the subject. The library is now almost complete on United States and State forestry publications. During the year 218 accessions were made, making a total of 1,286. All publications are topically catalogued as received.

*Press Bulletins.*—The press bulletin is an easy and economical way of presenting the subject of forestry to the public. There are over 500 newspapers on our mailing list, and they as a whole welcome our bulletins. The subjects are practical and popular, and it is believed that many of the papers throughout the State publish them. Many of the publishers do not send us a copy of their papers, but from the number of exchanges this office receives it is conserva-



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tively estimated that each of our bulletins appear in the State and local papers to the number of 300,000 single copies. It is fair to presume that at least one reader of each paper will read the bulletin. The cost of issuing a bulletin is about $7.00 for postage, printing and envelopes, and the total cost, which includes labor of mailing, does not exceed $10.00. The bulletins issued are reprinted in this report and are as follows:

[Press bulletin No. 20. Issued January 18, 1912.]

## PRIZES OFFERED FOR ESSAYS ON FORESTRY.

The State Board of Forestry for the past two years has given prizes to the pupils of the public schools for the best essays on forestry. This plan of interesting the school children and teachers in forestry has been so successful that the following offer is made for this year.

Four ten-dollar prizes will be given: One to the seventh grade pupils; one to the eighth grade pupils; one to the freshmen and sophomore high school pupils; and one to the junior and senior high school pupils.

The subject of the essay must be: "Woodlot conditions in the county in which I live and suggestions for their improvement." The essay must be limited to 1,200 words and a manuscript copy be sent to the secretary not later than November 1, 1912. For conditions governing the contest, write the secretary of the board at Indianapolis.

[Bulletin 21. Issued February 1, 1912.]

## PRUNE YOUR SHADE TREES

But do not mutilate them. Pruning does not mean cutting off the top of the tree and the ends of the branches. It means the removal of dead and defective branches. It means that one of two limbs that cross and rub each other should be cut off. It means that all branches that are removed should be cut off close to the axis of support and the wound treated with an antiseptic dressing. The practice of cutting off the ends of the branches not only destroys the beauty of the tree but positively shortens its life and invites early decay. If your trees are growing taller than you desire, it is because the trees are too close. Mature trees should not stand closer than thirty feet, and if they are planted closer they should be thinned when the ends of the branches begin to touch the tree next to it.

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It is rarely a shade tree grows too thick and it is safer to trust to nature to do the thinning than to one who is not an expert in doing this kind of work.

The State Board of Forestry has issued a thirty-seven-page bulletin on the pruning and planting of shade trees, which gives full directions with illustrations for the pruning of shade trees. This valuable book may be obtained free by writing to the State Forester at Indianapolis.

[Bulletin 22. February 15, 1912.]

## DOES THE WOODLOT PAY?

The woodlot should be regarded as a crop of trees. As such, is the woodlot a paying investment? Is it growing the most valuable kinds of trees and as many to the acre as it should?

An investigation of the woodlot conditions throughout the State show that the woodlots are not producing one-half as much as they should. There are over 4,000,000 acres of woodland in Indiana growing half a crop, which is equivalent to 2,000,000 acres of idle land. Can the State afford this? It is a deplorable fact that the woodlots are being neglected and owners should begin at once to improve them. The cost is small and the way easy.

The first thing to be done is to fence it and then keep all kinds of stock out of it. Browsing animals destroy the second growth, which is essential to a productive woodlot. Then the open spaces in the woodlot should be planted. This may be done by using nuts or seedlings. The quality of the stand should be gradually improved. When timber or fuel is needed, trees of a low commercial value should be cut, and replaced with more valuable species. When trees are cut they should be felled so as to do as little damage as possible to the standing trees; and when hauling as few trees as possible should be cut in making roads. It is best to maintain a few roads in the woods as outlets, which will also serve as fire lanes.

The principal trees to be removed are the beech, maples, black oaks, dogwoods, ironwood, sassafras and water elm. These have a low commercial value, and the beech and maples produce such a dense shade that nothing will grow under them. Three ash or yellow poplar will mature on the same area that is required by two beech or maple and, in addition, will permit a vigorous second growth which will take their place when they are cut. The trees that grow the most rapidly and have the highest commercial value, and for these reasons are recommended for planting, are the white

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ash, yellow poplar and black walnut. In addition to these the white, burr and red oaks, hickories and linn may be used.

The State Board of Forestry has issued two publications which give detailed descriptions of woodlot conditions and complete instructions for their improvement. These valuable books are free and may be obtained by writing the board at Indianapolis.

[Bulletin No. 23. February 29, 1912.]

## PREVENT FOREST FIRES.

All of our towns and cities are well equipped for fighting fires, and as soon as an alarm is given every one becomes interested in putting it out. By being well prepared for fighting fire, and by prompt action, the loss in a majority of cases is small and is usually fully covered by insurance.

Contrast this condition with our forest fires. In Indiana the township road supervisor is the legal fire warden, whose duty is, when he discovers a fire, to employ help to extinguish it. Are the road supervisors aware of their duty in this matter, and are they equipped for fighting a fire? Have they had any instruction as to how to control a forest fire? Is each district properly posted with "fire signs," which may be had free by writing to the State Board of Forestry?

The fact that the facilities for fighting forest fires are not good makes it more necessary to exercise great care in their prevention. The spring forest cleaning will soon be here and the utmost care should be exerted to prevent the escape of fire. When a woods or meadow burns over, the loss is always greater than generally considered. When a fire goes through a forest it not only kills the young growth, but the growth of the trees not directly injured by the fire is retarded for years, because the forest cover has been burned, which retains the moisture necessary for forest conditions. The loss in a forest fire is total because there is no insurance. However, if the loss sustained is caused by other than the owner of the property the state law provides: "That any person who shall set fire to any woods belonging to another or shall place a fire on his property and permit it to spread to the woods of another shall be liable to a fine of not less than $5.00 or more than $50.00 and be liable to the owner for the full damages sustained." If our fire law should be more rigidly enforced it would force people to be more careful and thus insure the safety of our forests.

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[Bulletin No. 24. March 14, 1912.]

## THE HARD OR SUGAR MAPLE AS A SHADE TREE.

The maples are used in Indiana more extensively for shade tree purposes than all other kinds of trees combined. There are four kinds used. The silver-leaf and red maple, commonly called the soft maples, are most frequently planted on account of their rapid growth. Their use should be discontinued because they are subject to the deadly attack of several common insect pests, and they grow long slender branches which frequently break off when loaded with ice. The Norway maple has recently been introduced, but is too low-headed to make a desirable street tree.

Our native sugar maple is by far the best kind of maple to plant along a street unless a small tree is desired. It will adapt itself to all kinds of soil, except a wet and undrained one. However, it grows best on a moist or dry, porous soil. The sugar maple has as yet been able to resist its insect enemies.

The trees for planting should be secured from the nursery and not be over eight feet high. Trees from the nursery will have a better root system and are not as likely to sun scald as trees transplanted from the forest. If the tree should sun scald, that is, a part of the body die, it is better to plant another tree than keep the defective one, which will begin to decay and die early.

When planting the tree do not cut off the top. All pruning should be confined to taking off the lower branches until the head of the tree is ten to twelve feet above the ground.

Shade trees as a rule are planted too close. A seventy-foot lot should not have more than two trees. After the tree is carefully planted place some kind of protection around it.

A booklet on the selection, planting and care of shade trees may be had free by writing the State Board of Forestry at Indianapolis.

[Bulletin No. 25. Issued April 4, 1912.]

## PLANT TREES ALONG THE HIGHWAYS.

The time has come when we should adorn our highways with trees. The old objection that trees prevented the mud roads from drying up has been removed since the roads have been macadamized.

The roadside tree not only furnishes grateful shade during the summer months, but at all times it modifies the intensity of the wind, protecting the traveler and the adjoining crops, and also in

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no small way protecting the adjoining fields from the drying action of the wind. It attracts and affords a shelter for birds, the farmers' friends. Since timber is getting scarce the value of the tree itself will almost pay for its growing. Then, too, trees add much to the appearance of a farm, and owners who have a nice row of trees along the road would not have them removed for any price. The beauty or appearance of the farm home and environment should not be neglected, and it is always worth more than it costs unless carried to extremes. The real estate dealer will tell you that the appearance of a farm adds much to its value.

With our industrial advancement we should not neglect the beauty of highways. Beautiful highways not only give pleasure to the eye, but elevate the tide of life, while the absence of beauty has a depressing influence.

The most desirable kinds of trees to plant are the hard maple, white ash, yellow poplar, elm and sycamore. The elm and sycamore should be planted in the low ground where the other species will not thrive. The white, red and pin oaks, walnut, hickories and wild cherry may also be used. The objection to nut-bearing trees is that they invite trespassers. The wild cherry is valuable in that it attracts the birds. The walnut and wild cherry are frequently defoliated by the tent caterpillar.

The tree selected for planting should be 4-6 feet long, with a good root system. It is a mistake to plant large trees and to cut off the top when planting. After the tree is well planted it should be protected by some kind of a guard. A book on the selection and planting of roadside trees may be obtained free by writing to the State Forester at Indianapolis.

[Bulletin No. 26. Issued April 18, 1912.]

## TREES ALONG THE FENCES.

Along the farmers' fences throughout the State the birds, squirrels and the wind have planted trees. Many are planted by these agents, but few are permitted to stand. The species most commonly found are walnut, wild cherry, ash, maple and elm.

Most of these, if cared for, would grow into valuable trees, but as generally found they show that they have been browsed, pruned with an ax or not at all, and with a trunk too short to make a twelve-foot log. Tall trees are more valuable and it costs less to grow them along the fence. They should be pruned up and not be per-

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mitted to form a fork until the height of a good length sawlog is reached. When the top of the tree is high the shade is so widely distributed that it has little effect on the adjacent crop.

Trees along the fences add beauty to the surroundings. They attract our birds and often serve as a retreat from the storm and birds of prey.

The workman in the field welcomes them as a place where he and his horses can enjoy their shade and cool breezes.

Stock of all kinds in the field will seek the shelter offered by a tree from the hot rays of the sun and from storms. It is true that occasionally an animal is killed by lightning under a tree, but during a storm animals first seek trees, and if there are none they will huddle closely up against a fence, and more animals are killed along fences than under trees.

Some farmers purposely leave a few trees along the fence in each field. This practice, as well as the planting of trees along the roadside, is to be encouraged.

[Bulletin 27. Issued April 25, 1912.]

## TREES OF INDIANA.

THEIR BOTANICAL DESCRIPTION, DISTRIBUTION, USES, GROWTH, ETC., IN A REPORT JUST ISSUED BY STATE BOARD OF FORESTRY.

The State Board of Forestry, in response to a demand from teachers, pupils, landowners and millmen for information on the trees of Indiana and their uses, have devoted the greater part of their 1911 report, which has just been published, to this subject. This report illustrates each species of forest trees of the State, with a full-page drawing, and gives a detailed botanical description of each species, with its distribution in the State. The economic uses of the different kinds of wood are given, together with a table showing the comparative weight of the different woods. The horticultural and forestal values of many species are discussed in detail, and information is given as to the best kind of trees to plant for ornamental and forestal purposes.

It also contains the results of an extended study of the rate of growth of certain kinds of trees, to determine the number of years it will take them to acquire saw-log size.

Statistics on the wood-using industries of the State have been collected which show what kinds of wood are used in the State and what articles are manufactured. They also show how little our Indi-

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ana forests furnish to keep these industries alive and how much must be bought outside of the State.

An excellent article on the climate of Indiana has been contributed also. It gives the annual amount of rainfall for the State; the average temperature; date of the first and last killing frosts.

With the aid of this book one can learn the different kinds of trees of the State, where they are found and for what they are used. Any one interested should write at once for a copy. It is a large book of 372 pages and costs 15 cents to mail it. It may be obtained free by writing to the State Forester at Indianapolis, Ind.

[Bulletin No. 28. July 10, 1912.]

## FORESTRY

### TO BE ENCOURAGED BY VISITORS' DAY AT FOREST RESERVE, JULY 25, 1912.

The State Board of Forestry has named the above date as a special day on which to show visitors over the Forest Reserve to see what can be done in growing forest trees. Special arrangements have been made to meet all cars and trains with free carriages to convey visitors over the grounds. Guides have been provided who are familiar with the forest plantings and will explain the object of each forest experiment and detail the progress made.

The Reserve contains 2,000 acres and has forty-five tracts planted to trees. The kind of trees planted are those that give the greatest promise of being the best kind for planting in Indiana, such as ash, catalpa, chestnut, coffeenut, cottonwood, elm, hickory, linn, locust, oak, sycamore, walnut, wild cherry and yellow poplar.

The trees are planted at varying distances apart, to learn what effect the spacing has on the rate of growth and in making the tree grow straight and free from branches. Some of the trees are cultivated and others are not, to show the value of cultivation. Some of the trees are given a severe pruning; some are given only a moderate pruning; while others are not pruned at all, to show side by side if a forest tree should be pruned, and if so to what extent. A steep hillside and the slope of a high bank of a creek which were too steep and washed even for weeds or grass to grow on them, have been planted to black locust. While it appears impossible to grow trees on such places, yet in three years some of the trees are twelve feet high. This demonstration alone is worth the cost of the visit.

The entire work is of an experimental character and is carried

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on in a practical manner. Every landowner and school teacher should visit this experimental station to learn what kind of trees to plant in Indiana and how best to manage them. One teacher recently spent three days studying the several forest tracts.

The Reserve is located in Clark County, one mile north of Henryville, and can be reached by the Pennsylvania Railroad between Indianapolis and Louisville, or by the Indianapolis and Louisville Traction Line. All local cars stop at the Reserve. Refreshments will be sold on the grounds. Come early, because you will have to travel over ten miles to see all of the plantings. Address all inquiries to the "State Forester," Indianapolis, Ind.

[Bulletin No. 29. August 1, 1912.]

## CONCRETE FENCE POSTS.

Can concrete line fence posts be made to take the place of wood posts? If they can, there will be a great saving of our forests; and it will be much more economical for the consumer. Their use will also modify to some extent the management of the woodlot and the abandonment of the planting of catalpa and locust, etc., for post purposes.

The State Board of Forestry is gathering information on their use in this State. They desire to learn to what extent they are used and with what success. The board will greatly appreciate the favor of a report from those who read this article and have had experience with concrete line posts. Write to the State Forester, Indianapolis, Ind., stating how many posts you have and how long they have been set; whether you bought ready-made posts or if you made them yourself; if purchased, at what price; give size; how reinforced; and any other information you deem of importance.

Concrete line fence posts are already successfully used in many parts of the State and it is confidently believed that their use will soon be general. It was only a few years ago that concrete sidewalks were considered a failure, and we shall not be surprised if it will take some time to learn how to make a durable fence post. It is an important thing to perfect a concrete post, when it is considered that there are at least a million fence posts used each year in Indiana.

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[Bulletin No. 30. August 15, 1912.]

## OUR DESERT HIGHWAYS.

When one journeys over the principal roads throughout our State, he is surprised that there are so few trees planted along the highways. Generally the few trees found are volunteers which have miraculously escaped their many enemies.

The question naturally arises, why are our roadsides destitute of trees? The principal reason is because the owner can not protect them. The roadside tree is nobody's tree or rather everybody's tree. The trunk is patched with signs, sale bills, etc., and perforated with nails. The branches must furnish gads for driving stock. The traveler, wearied by his horse fighting flies, breaks off the smaller branches and fastens them to the harness in lieu of fly nets. The telephone man regards trees as an arch enemy and sometimes so badly mutilates them that they are offensive to the aesthetic sense, and we wish he had cut them close to the ground to end their miserable existence. The practice of using roadside trees as guy poles is very injurious to them. The small boy finds delight in climbing in them, breaking off the branches, and in clubbing them, especially if they are nut bearing trees. Their grateful shade causes them to be used as hitching posts, and the tied animals usually lunch on them.

The objection that trees prevent the roads from drying up quickly is much more than balanced by their grateful shade. It is true it takes some space to grow a tree but the value of the crop shaded by the tree is far less than the value of the tree to the public, the value of the wood produced and the added appearance to the farm. The time has come when our best farmers appreciate the value of roadside trees and are eager for the time when they can plant trees with a reasonable assurance that they will not be destroyed. Laws are needed to protect roadside trees and every property owner should urge his representatives to pass laws protecting trees along the public highways.

[Bulletin No. 31. September 6, 1912.]

## BLACK LOCUST SEED WANTED BY THE STATE BOARD OF FORESTRY.

The black locust is excelled only by the hedge or osage orange as a post timber. It grows rapidly and does well on rocky, worn out and eroded fields. It is the most easily propagated of any of our trees; all that is necessary is to get the roots covered with

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earth and it will grow. It will grow better without cultivation than any other of our valuable trees, which recommends it for planting steep hillsides and rocky places that can not be cultivated. For the preceding reasons it would be the most desirable tree to use in reclaiming the rocky, deserted and washed fields of Indiana, if it were not for the fact that it is often killed by the borer.

It has been observed, however, that volunteer locust trees that have sprung up along the roadside from trees that were brought to this country by our grandfathers are often free from the attack of the borers, while trees nearby that have been secured from a nursery are badly affected.

This is attributed to the fact that the parents of the volunteer locust have resisted the attack of the borers for so many years that their descendants are practically immune to the borer, while the trees from the nursery, which are grown from seed imported from Europe, have not yet become "acclimated."

This is a significant fact and the State Board of Forestry has decided to undertake the experiment of growing a strain of black locust that will be more or less immune to the borer. They expect to plant seed from at least 100 young, thrifty trees that are free from the borer. From these seed, trees will be grown and from these trees, seed will again be selected from such trees as show a rapid and upright growth and are as free as possible from the borer. Again, seed will be planted and the process of selective breeding continued until satisfactory results are obtained.

The board wishes to receive seed from every county in the State, but to send a man to all parts of the State to collect seed would mean a great expense and one which the Forestry Board can not meet. For this reason, is asked the favor of the collection of 200 seed from each of one to five thrifty young trees 6 to 10 inches in diameter at 4½ feet above the ground. It takes only a few pods. to furnish 200 seed. Take the seed out of the pod, wrap them securely in a paper and write on the package the circumference of the tree at 4½ feet above the ground, the estimated height and the locality of the tree. Remember to keep the seed from each tree separate. Send to the State Forester, Indianapolis, Ind., who will reimburse you for postage or express. This favor will be greatly appreciated by the board and it is hoped that some one from every county will respond and assist in this important undertaking.

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The subject of the prize essay for 1912 was "Woodlot Conditions in the County in Which I Live and Suggestions for Their

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MISS GERTRUDE LOGUE. MISS FERN SWANSON.

PLATE No. 15. Successful contestants in the Forestry Prize Essay for 1912.

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Improvement." The following conditions were also imposed: (1) At least five woodlots should be visited and the number of acres in each lot given. (2) The contestants should report on each woodlot, making the following observations:

(a) The amount and effect of grazing.

(b) The amount, frequency and effect of forest fires.

(c) The number (estimated) of trees per acre and give approximate size.

(d) The principal species of trees in the stand and state the relative abundance.

(e) The condition of the forest floor.

(f) What effort, if any, are the woodlot owners making to improve their woodlots?

After it was too late it was learned that the subject with the conditions was too difficult for the pupils of the graded schools, and as a result no one entered the contest. However, the pupils of the high schools did good work. Some teachers used the subject as a theme for forestry work and required the pupils doing this class of work to write an essay upon this subject. The best work done was by the biology class of St. Mary's-of-the-Woods, which was exceptionally thorough and well done. From this school eleven essays were received, two of which were awarded prizes. The prize for the best essay from the freshmen and sophomore classes was awarded to Miss Fern Swanson of Williamsport, Ind. The prize for the best essay from the junior and senior classes was awarded to Miss Gertrude Logue, now of Marshall, Ill. (Plate 15.)

The subject of the prize essay for 1913 is "Street and Roadside Trees in the County in which I Reside."

## FIELD WORK.

The field work in the main consists of inspections of woodlots and forest plantations. The woodlot investigations have been confined to visits of inspection at the request of the owners. The woodlots visited have invariably been pastured, many have a blue grass floor and a meagre amount of young growth.

The forest plantations visited reveal the same conditions as were discussed in our report for 1910. They show a lack of knowledge as to what species to plant and as to the proper management of the plantations. A list of the plantations visited is given in order that any one interested in visiting the different kinds of



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forest plantings may know the area of each and how to reach them. The exact location of any planting may be obtained by writing to the secretary of the Board of Forestry.

| County. | Town. | Owner. | Species. | Trees. | Acres. |
|---|---|---|---|---|---|
| Allen | Fort Wayne | Chas. McCulloch | Catalpa | | 3 |
| Allen | Fort Wayne | Rockhill Estate | Catalpa | | 2 |
| Bartholomew | Edinburg | P. R. King | Black locust | 53,000 | |
| Decatur | Greensburg | Woodfill & Ford | Black locust | 92,500 | |
| Dubois | Birdseye | H. T. Koerner | Black locust | | 9 |
| Elkhart | Middlebury | Ed. Funk | Catalpa | 4,000 | |
| Elkhart | Middlebury | G. M. Lehman | Catalpa | 725 | |
| Elkhart | Middlebury | Henry Lehman | Catalpa | | 1 |
| Elkhart | Middlebury | S. J. Litwiller | Catalpa | 1,000 | |
| Elkhart | Middlebury | J. S. Mather | Catalpa | | 1 |
| | | | Black locust | 700 | |
| Elkhart | Middlebury | Wm. F. Messner | Catalpa | 2,200 | |
| Elkhart | Middlebury | S. E. Plank | Catalpa | 3,000 | |
| Elkhart | Middlebury | David Speicher | Catalpa | 2,000 | |
| Gibson | Owensville | Henry Mowrer | Catalpa | 3,000 | |
| Gibson | Owensville | Geo. W. Smith | Catalpa | 3,000 | |
| Hamilton | Carmel | Jonathan Johnson | Catalpa | 1,000 | |
| Hamilton | Arcadia | Monroe P. Trietsch | Catalpa | 1,945 | |
| Hancock | Wilkerson | J. P. Reeves | Catalpa | 500 | |
| Hancock | Wilkerson | J. R. Williams | Catalpa | 1,000 | |
| Hendricks | Danville | Chas. Higgins | Catalpa | 2,000 | |
| Hendricks | Danville | Chas. McLane | Catalpa | 2,000 | |
| | | | Black locust | | 2 |
| Hendricks | Plainfield | Geo. Jessup | Catalpa | 1,500 | |
| Henry | Spiceland | Albert Hodson | Chestnut | 300 | |
| | | | Catalpa | 1,000 | |
| Howard | Fairfield | E. A. Armstrong | Black walnut | | 4 |
| Jasper | Goodland | Geo. Welch | Catalpa | 3,000 | |
| Jasper | Remington | A. D. Wooden | Black walnut | | 1 |
| | | | Soft maple | | 3 |
| Jennings | Scipio | A. R. Thompson | Catalpa | 300 | |
| | | | Black locust | 1,000 | |
| Jennings | Scipio | John R. Thompson | Catalpa | 4,000 | |
| Jennings | Scipio | No Man's Land | Black locust | | 7 |
| | | | Catalpa | | 4 |
| Knox | Bicknell | Ed. Dellinger | Catalpa | 486 | |
| Knox | Bicknell | Morton Fox | Black locust | 6,500 | |
| Knox | Bicknell | A. P. Kuhn | Catalpa | 1,500 | |
| Knox | Bruceville | Art Cox | Catalpa | 8,000 | |
| | | | Black locust | 8,000 | |
| Knox | Bruceville | Lee House | Catalpa | 1,000 | |
| Knox | Bruceville | Sam Huddle | Black locust | 1,100 | |
| Kosciusko | Leesburg | Chas. Holderman | Catalpa | 2,500 | |
| Lake | Crown Point | C. B. Benjamin | Catalpa | 1,000 | |
| Lake | Crown Point | John M. Hack | Catalpa | 1,707 | |
| Laporte | Laporte | William Niles | Black walnut | 1,000 | |
| Orange | Paoli | Sebastian Kuri | Mixed hardwood | | 20 |
| Owen | Cataract | C. W. Oakes | Black locust | 10,000 | |
| Spencer | Grandview | J. H. Thomas | Black locust | | 6 |
| Spencer | Grandview | Dr. J. T. White | Black locust | 12,000 | |
| Spencer | Rockport | Frank Hall | Black locust | | 5 |
| | | | Catalpa | | 4½ |
| Spencer | Rockport | Wayne Meredith | Black locust | | 3 |
| Sullivan | Fairbanks | Willis Drake | Black locust | | 1 |
| Sullivan | Fairbanks | E. P. Thompson | Catalpa | 1,000 | |
| | | | Black locust | 1,000 | |
| Sullivan | Shelburn | William Riggs | Catalpa | 2,000 | |
| Warren | Attica | R. L. Winks | Catalpa | | 1 |
| Warrick | Boonville | T. P. Littlepage | Catalpa | 150,000 | |
| | | | Black locust | 150,000 | |
| Washington | Harristown | James K. Elliott | Catalpa | 400 | |
| | | | Black locust | 1,500 | |
| Total | | | | 545,283 | 73¾ |

Number of plantings visited, 51.

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## LOCAL FORESTRY ASSOCIATIONS.

This spring an attempt was made to form county forestry associations. Henry County was selected for trying out the plan. This county is wealthy and has always been prominent in agriculture and horticulture, and livestock growing.

The time selected for the preliminary meeting was one when the woodlot owners would not be busy and the severity of the weather would not prevent an attendance. Accordingly, Wednesday afternoon, March 7, 1912, was named as the most auspicious date, and the meeting was held in the court house at New Castle. The meeting was given publicity by advertising in the two daily papers for two weeks preceding the meeting, by two days' personal solicitation in the county by the secretary and by mailing 216 personal letters to woodlot owners who would be the most likely to be interested in the improvement of their woodlots. Enclosed with each letter was a printed letter setting forth the conditions of the average woodlot and reasons for their improvement.

When the meeting was called to order more than sixty woodlot owners were present. Prof. Stanley Coulter, Dean of the School of Forestry of Purdue University, headed the program with a discussion of the woodlot. He very vividly portrayed the conditions of the average woodlot, and gave reasons and suggestions for their improvement. His able address was followed by an informal discussion of the subject by the persons present, which lasted for over an hour. At the close of the meeting a local forestry association of twenty-four members was formed and called the Henry County Forestry Association. John H. Hewitt was chosen president and Lynn C. Boyd secretary. The address of the president and secretary is New Castle.

## COUNTY COOPERATIVE PLANTATIONS.

It has been learned through our field work that there are landowners who do not know of the existence of the forest experimental station and many who declare they would visit it if it was more accessible. The Reserve is located in the very southern part of the State on only one railroad line, which makes it necessary for the greater number of the people of the State who desire to visit it to take three days to do so. This takes more time and costs more than the average person is willing to spend.

In view of the preceding situation it seems advisable to conduct co-operative work in other parts of the State and if possible in every

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county. In the ninety-two counties of the State there are 18,884 acres in county farms, an average of over 200 acres for each county. The largest areas are in the southern part of the State where practical forestry is most needed. It is proposed to do some kind of practical forestry on county farms that have woodlots or eroded or washed fields. The idea would be not to do experimental work, but to demonstrate locally real practical forestry so that persons who wish to do forest planting or improve their woodlots could see approved methods near home. It is believed also if demonstration areas were established in each county that it would give a great impetus to constructive forestry.

With the above ideas in mind the secretary under direction of the board visited the county commissioners of Clay, Daviess, Martin, Morgan, Putnam and Spencer counties and presented the subject of co-operative work to them. The commissioners of all the counties approved of the plan, but hesitated without due deliberation to appropriate the little money necessary to buy seedlings. They requested that the secretary return at their next meeting at which time the subject would again be considered. However, a second visit was not possible for lack of funds.

The commissioners of Martin County were very much impressed with the proposition, because their county contains so much eroded and hilly land. Their county farm contains 357 acres and has several cleared fields which are so badly washed that they are no longer profitable for either grazing or field crops. One of these fields lies just west of the buildings and along the public thoroughfare and will be planted next spring with seedlings of locust, ash and tulip. A ravine traverses the tract from north to south dividing it into two nearly equal parts, so the field is really two hillsides. The west slope will be planted by the "rock in" method and the east slope will be prepared as for corn to contrast the two methods of planting. The ash and tulip were native species on these slopes.

It is expected to extend the work at this place as fast as time and money will warrant. It will always remain to the credit of the Martin County commissioners to have initiated practical forestry on county farms. They deserve the honor of having their names recorded in this report. They are Albert T. Ackerman of Loogootee, Jas. N. Hert of Indian Springs, and Chas. Pinnock of Shoals.

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# Suggestions for the Improvement of Indiana Woodlots.

BY STANLEY COULTER, PH. D., DEAN OF SCHOOL OF SCIENCE, DIRECTOR OF LABORATORY, PURDUE UNIVERSITY.

The papers previously published in the annual reports of the State Board of Forestry concerning woodlot conditions and possibilities in Indiana[1] proved to be of sufficient value to lead the board to ask that they be rewritten and expanded for the current report. The present paper, however, which is prepared in response to that request, is more in the nature of a series of practical suggestions for the improvement of the woodlot than a combination and expansion of the previous papers.

It is, however, necessary to give a brief resume of the observations set out in those papers, since they furnish the basis for the present article.

It was shown, that the problem of the future of the forests of Indiana was the problem of securing the proper management and care of the small timbered areas held by individual owners. It was claimed that if such areas were wisely handled and conservatively lumbered there was no reason why they should not for years yield a steady and increasing income and at the same time show a marked increase in quality and value. It was shown that the problem of the future timber supply was very largely a problem of education; that individual owners of timbered tracts must realize the value of such holdings and train themselves in methods of management which would secure the unimpaired maintenance of these holdings.

An examination of the woodlots of the State showed the following conditions to be almost universal:

1. Practically all are used as pasture land and the great majority are so heavily overpastured as to preclude any possibility of natural regeneration.

[1] Ninth Annual Report, Indiana State Board of Forestry. Woodlot Conditions and Possibilities: Stanley Coulter, pp. 36-47.
Tenth Annual Report, Indiana State Board of Forestry. Woodlot Conditions and Possibilities, II: Stanley Coulter, pp. 126-135.



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2. In a very large number of instances the tracts have suffered a more or less serious damage by fire.

3. Very few if any of the wooded areas are carrying their full load of timber. In very few would the cut exceed 2,500 feet B. M. per acre; it should run 7,500 feet B. M.

4. That as a result of long continued selective cutting of the more valuable species the present stands are composed very largely of inferior species.

5. That in almost every woodlot "cleaning cuttings" are needed to remove undesirable forms. Such cleaning cuttings should remove all forms, the absence of which would improve the forest and give the trees left standing an opportunity for a more perfect development. Ultimately, such cleanings should remove all trees, which even if allowed to reach full maturity would never have an economic value, such as the haws, dogwood and sassafras. It should also include all trees that are dead or dying or are fully mature.

6. That in some cases "thinnings" are evidently indicated. Often several trees of a valuable species stand so close together that no one of them can develop into a good tree. In such a case "thinning" is necessary.

7. That a more thoughtful utilization of the existing stand is everywhere imperatively demanded to secure the best results. This means a checking of the tendency to cut such trees as will work up most easily whatever may be the purpose for which they are to be used.

## WOOD-PASTURES VS. WOODLOTS.

A very large proportion of the wooded areas of Indiana are *woods-pastures.* As such they may serve a very useful purpose, but they should not be regarded as woodlots nor should they be considered in any discussion of the future timber supply.

In the woods-pasture the desire is to increase the supply of grass at the expense of the forest floor. The tract is conserved, not for the maintenance and improvement of the timber, but for the purpose of furnishing shade and forage for cattle. With this conception of its use the wooded area becomes less and less valuable, regeneration is impossible and its complete disappearance is merely a question of time. More rapidly destructive is the common and increasing practice of using the woodlot as a range for hogs.

In the woodlot, on the other hand, the purpose is to improve the stand both in quantity and quality, or, at the very least, to maintain it in an unimpaired condition. With this purpose in

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view, grass is regarded as an undesirable weed, and any agency which hinders regeneration or interferes with the normal development and growth of the young seedlings as a positive injury.

It is extremely important at the very beginning that it should be held clearly in mind that woods-pastures and woodlots are essentially different things. That this basic fact is not generally recognized is shown by the large number of requests for lists of trees "under which blue-grass will grow." The wooded area should be made either a good woodlot or a good woods-pasture; it cannot be both.

## WHAT IS A GOOD WOODLOT?

If the purpose is to make a good woods-pasture this question need not be discussed since all that is needed is to continue the present practice. If, however, the purpose is to make a good woodlot it is first necessary to know its characteristics.

A good woodlot is one which carries a full load of trees of desirable species in proper proportion; in which the forest floor, made up of fallen leaves and twigs, is sufficient to keep the soil fertile and moist and mellow; in which the crowns are sufficiently close to hold in check grass and weeds; and in which an abundance of healthy and vigorously growing species are at hand to take the place of the mature trees as they are cut. These are what may be called its *positive* qualities. The good woodlot, however, can be recognized just as surely by certain *negative* characters. It is free from misshapen and dead trees; it is free from trees which are infested by insects or fungi; it is free from worthless species or tree weeds; it is free from fallen logs and unused tree tops which serve as breeding places for insects and prevent regeneration in the spaces which they cover; it is free from briars and other thick undergrowths which smother out the young seedlings; it is free from the burden of pasturage.

It is very evident that such a woodlot is the result of intelligent care given through a series of years. It is as impossible to secure a good timber crop without care as it is to secure a good crop of corn or potatoes without care. The average landowner does not give this care, claiming that trees will grow without it; that as forests have reproduced themselves in the past they will continue to do so in the future. Doubtless this is true in a certain sense, but with care this future reproduction will be more rapid and certain and of better quality and larger quantity. Grass has reproduced itself in the past and would doubtless continue to do so in the

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Photo by M. F. West.

PLATE No. 16. Ailanthus on Madison hill. Hills were formerly entirely denuded of trees and soil washed away.

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future. but no intelligent landowner relies upon the natural reproduction of our wild grasses for his hay crop. No one will be able to develop a good woodlot without a clear notion of its characteristics and without a recognition of the fact that it is the outcome of intelligent, persistent care.

## PROTECTION FORESTS.

Quite apart from the woodlot and serving, in the main, a different purpose is the protection forest. In our State these are of two kinds: first, to prevent erosion through rapid run-off in hill regions and second to serve as windbreaks. In the southern part of the State, thousands of acres of land which have been stripped of their timber are wasting with enormous rapidity. The only possible use to which this land can be put is to timber growing. If the waste is allowed to continue for many years longer all of this large area will become permanently unproductive. Fortunately, the conditions are such that the greater proportion of these areas can be reclaimed by simply freeing them from the burden of pasturage. In most cases there is a sufficient number of seed trees to restock the land, not evenly or thickly perhaps, but sufficiently to check waste. "In the hill regions of the southern counties, and especially in localities where the hills faced the Ohio River, the forests were removed many years ago. For years such tracts were left unfenced, and during those years the land wasted through erosion and no seedlings obtained a foothold. At a later period when laws prohibiting stock from running at large were passed and when wire fencing came into general use, these denuded hills were quickly covered with a dense growth of young trees. No planting had been done, the soil had received no treatment, the tract was merely freed from the burden of pasturage."[2]

Through the co-operation of Professor Glenn C. Culbertson of Hanover College, I am able to illustrate this condition from photographs taken in Jefferson County.

The Ailanthus or "tree of heaven" happens to be of no economic value so far as our wood industries go, but it has certainly proved its value as a "soil fixer" in thin soils on steep slopes. (Plate 16.) The hills in the immediate vicinity of Madison, where the photograph was taken are very steep, no cultivation being possible in any part except after terracing. It also makes a very rapid growth under these apparently unfavorable conditions. In Plate

[2] Indiana State Board Forestry, Tenth Annual Report, 1910, p. 37.

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Photo by M. F. West.

PLATE No. 17. View of Ailanthus, showing size of a number of trees—one foot or more in diameter, Madison, Ind.

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Photo by M. F. West.

PLATE No. 18. Red Cedar covering a denuded hill near Madison, Ind. Notice extent and character of erosion.

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17 the larger trees are over a foot in diameter, breast high; their age is between twenty-five and thirty years. When this growth rate is compared with that of such a relatively rapid growing native tree as the white ash, which requires an average of one hundred years to reach a diameter of a foot, it suggests at once the desirability of investigations touching possible utilities of this species.

The red cedar is another species which has proved extremely effective in the reclaiming of steep slopes, and one which has the added merit of possessing an ecomonic value in a relatively short time. Plate 18 shows the first steps in the reclamation of a denuded hill by red cedar, the first foothold being obtained near the foot of the hill and progressing gradually upward. The view also shows in an admirable fashion the extent of the previous erosive action.

In Plate 19, there is shown an example of arrested erosion by means of the circle of cedars about its boundary. In this view also the destructive extent of the erosion is clearly indicated. Doubtless, within a very short time the erosion gully itself will be filled with cedars.

The value of a tree covering as a protection against soil waste and as a means of utilizing the land to the fullest extent is sufficiently evidenced by these illustrations. Every bared and wasting slope, whether large or small should be compelled to carry its due crop of trees. As has been suggested, protection against pasturage will in almost every case be all that is necessary to accomplish this result. The landowner should realize that unproductive areas upon his farm are wasteful in the extreme and an almost infallible sign of incompetent management.

Windbreaks or protection belts of trees have not been used in Indiana as widely as conditions demanded. In the northern, but especially in the northwestern counties, practically every farm should have a series of properly located and carefully planted windbreaks. Their importance in ameliorating climatic conditions in furnishing shelter for stock and from an aesthetic standpoint are too obvious to need discussion in this connection. In the matter of increasing existing wooded areas, the duty of the landowner is clear; unoccupied and unproductive hills and slopes, especially those subject to erosion, should be so managed that they will develop a tree covering, and protective belts or windbreaks should be far more widely planted than at present. The neglect of these duties means in the one case, financial loss; in the other, discomfort and an indirect financial loss.

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Photo by M. F. West.

PLATE No. 19. Red Cedar arresting the advance of an erosion gully, Madison. Ind.

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## INFECTED TREES.

In the improvement of the existing woodlots, perhaps the most imperative necessity is the removal of infected trees. The number of trees affected by the various fungi in our Indiana woodlots is positively appalling. When it is recognized that each of these trees serves as a center of infection, the future peril becomes plain.

FIG. 1. Quercus imbricaria (Shingle Oak) attacked by Polyporus.

These infections show themselves in various ways, but usually their presence is not evident to the untrained observer until the time for remedial measures has passed. Perhaps the most familiar forms of infection are those due to some of the many species of Polyporus, commonly known as shelf-fungus. Scarcely any species of trees is exempt, and when the large shelf-like bodies appear not only is the affected tree doomed, but it becomes a positive menace to the other trees in the tract. At times the fungus attacks the entire trunk, as shown in Fig. 1.

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At other times it appears in scattered bracket-like groups upon the trunk. (Fig. 2.) The large shelf structures are spore bearing bodies giving rise to multitudes of minute spores which are carried by the wind to find an ultimate lodgment upon some other tree.

An examination of Figures 1 and 2 will show a very definite relation existing between the location of the fungus and the seat of

FIG. 2. Populus deltoides (Cottonwood), showing scattered, bracket-like groups of Polyporus.

a former injury. As a rule, the fungus gains access to the living tissues of the tree by way of an external wound. In some cases the fungus seems to follow this wound closely, not appearing, at least externally, beyond its boundaries. This condition is well illustrated in Fig. 3.

Where such trees are present the woodlot is doomed unless remedial measures are promptly taken. The only effective remedy is the complete removal of the infected trees. Much of the wood can

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be used for fuel or other minor purposes so that the loss will not be complete. The effect of this treatment will be lost *if the tree is not entirely destroyed.* Such parts as can be utilized should be promptly hauled from the woods, and that which cannot be utilized should be burned. The purpose of the cutting is to remove a center of infection and thus protect the forest from deterioration. A

FIG. 3. Soft Maple, showing Polyporus igniarius closely following the lines of a former injury.

fungus infected tree if allowed to remain upon the ground is just as dangerous, just as certain to spread infection as if it had been allowed to remain standing.

## INSECT INFESTED TREES.

It is fortunate that in woodlot and forest conditions our native trees are not as a rule seriously affected by insects. Occasional species in occasional years may be defoliated or attacked in other

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ways, but as a rule the danger is not so serious as that from fungi. In new plantings, however, damage from insects is apt to be serious, so serious indeed as to preclude the planting of certain species. In certain regions of the State it is unwise to plant black locust because of the locust borer, which in some cases will destroy from 30 to 40 per cent. of the entire stand. In other localities catalpa is unsafe because of the catalpa sphinx, which frequently defoliates every tree in a planting. The woodlot or native forest fortunately presents no such conditions. Care should be taken to destroy the breeding places of dangerous insects. These breeding places in our woodlots are most frequently brush heaps, decaying logs and rotting stumps. An examination of a decaying log will reveal scores of different kinds of insects; some in the bark, some just beneath it, some burrowing in the wood, some between the log and the ground. If a brush pile is stirred, swarms of insects will be found to have utilized it as a breeding place. The removal of such breeding places reduces the danger to the minimum. If a tree is infested it should be kept under observation, and if it is attacked a second year it should be cut down and completely removed from the tract, or burned. If any part is left undestroyed the work is useless. If the trees of a given species show a liability to insect attacks, it is a sufficient indication that the species is one to be replaced as rapidly as possible by another which is more immune to insect attacks. In the case of the woodlot as it stands the chief problem is to keep the trees healthy and vigorous in order that they may make a rapid and profitable growth. This can only be accomplished through a close and persistent observation of the woodlot and the adoption of prompt remedial measures when the necessity arises.

## IMPROVEMENT CUTTINGS.

"The three principal aims in caring for the woodlot should be: to keep the ground thoroughly covered with trees; to have only the best possible trees; to make them grow rapidly."[3] It is very evident that to meet the second of these purposes, the woodlots of Indiana must be given improvement cuttings or cleanings. It must be emphasized, however, that improvement cuttings are to be made *gradually*. The sudden change in conditions which would necessarily result from a heavy improvement cutting would inevitably seriously injure the woodlot. The exposure of considerable areas

[3] The Improvement of the Woodlot: Walter Mulford. The Cornell Reading Courses, Farm Forestry series No. 1. p. 132. March, 1912.



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to the direct action of the sun, the increased danger from windfall, the injury to young growth because of the removal of the needed shade of their earlier years, are but a few of the evils that follow too vigorous cleanings. The *best possible trees* is the end to which we are directing our efforts. Perhaps the best starting point is to be found in the removal of trees which are plainly badly diseased and which constitute dangerous centers of infection. In some cases, however, such trees are so numerous that their removal at a single operation would be dangerous. A safe practice is to select the trees that are to remain, rather than those which are to be removed. When it is decided that a given tree should remain it is fairly easy to determine what should be removed to give it the best chance for growth and development. Ordinarily this will not be found to require an excessive clearing of the ground. Later as the tree grows in height and spread of branches, additional cuttings may be made if necessary for its further growth. In the matter of improvement cuttings it is impossible to give any definite statement as to the amount which may be cut safely. This is a matter of individual judgment based upon the conditions existing in the particular case in hand. I should say, that not more than 15 to 20 per cent. of the area should be uncovered at a single operation and the cuttings should not follow each other within less than five years. Mulford[4] gives the following detailed suggestions which will be found exceedingly helpful.

1. Do not give a young tree so much room that the lower part of its trunk will not be cleaned of branches. There is no danger that new branches will start out on those parts of the trunk that have been well cleaned of limbs.

2. Even after the tree is well cleaned, do not give it so much room that it develops a wide-spreading crown instead of a compact one.

3. Do not make an opening so large that it will not be filled by the surrounding crowns within a few years, otherwise the soil may run wild.

4. Since an opening should not be very large, it is a good plan not to cut two trees whose crowns adjoin unless there is a special reason for doing so.

5. Do not thin so severely that on a clear day you will see more than one-third of the ground with the bright sunlight reaching it; the sunlight should be in small patches here and there.

[4] Improvement of the Woodlot: Walter Mulford. loc. cit. p. 117.

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The danger from too heavy improvement cuttings at a single operation is so great that too much insistence cannot be placed upon the necessity of caution in this work. Ultimately, the improvement cuttings are to remove not merely insect and fungus affected trees, but also those that are misshapen, or of undesirable species.

### SELECTION OF TREES TO REMAIN.

Several factors should enter into the determination of what trees are to remain for further development. First in importance is the species. The desire is to secure as large a proportion as is possible of the *best trees*. This means that *species* of high economic value are to be favored; promising young white oaks, for example, should not be cut in order to give a hackberry or cottonwood opportunity to develop even though the latter were larger trees. The *form* of the tree is also of importance. Trees with clean, straight trunks and with branches set high are to be favored over trees of equally good species, which branch low or do not have straight trunks with but slight taper. The form of the *crown* should also be taken into consideration. The crown practically determines the quantity and quality of the wood. The best crown is one that is compact and is carried high on the trunk. It should be fairly uniformly developed in all directions; if crowded so that its symmetrical development is prevented the trees which interfere should be removed. A tree with a scanty or scattered crown cannot make satisfactory growth. In the selection of trees which are to remain, these three features should control: good species; clean, straight, long trunk; high, compact crown.

As these improvement cuttings are being made gradually, the resulting openings are not excessive in size so that the forest floor is not seriously disturbed. During the operations much valuable material, such as fuel, posts, rails and smaller dimension stuff is secured, greatly reducing the cost. In very many cases it has been found that under fairly careful management, the material removed in the improvement cuttings has equalled or exceeded in amount the cost of the operation. The net result of improvement cuttings should be a woodlot made up of trees of valuable species, with clean, straight trunks and high, compact crowns. It should be free from fungus infected trees, and from the ordinary breeding places of insects. Such a result, however, can only be secured by intelligent, persistent care.

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## INCREASING THE STAND.

Not only should the woodlot be made up of healthy, vigorously growing trees of desirable species, but it should carry its full load. It is an extremely conservative statement that the woodlots of Indiana are not carrying one-half of their possible load. Put in another way, four million acres of woodlots in the State are carrying less timber than two million of acres should carry, a clear loss of the returns upon two millions of acres. Such enormous waste is not merely inexcusable, it is really criminal. Not only are the woodlots not carrying more than a half load, but the composition of the stands is poor. "The successive operations leading to present woodlot conditions are not difficult to trace. Where lumbering began in Indiana only the best trees of the most valuable species had a market value, and, as a consequence, these only were cut. Defective trees and those of inferior species having no market value were left. Later, as the demand for lumber became greater, and smaller material became valuable, the forest was cut over and again only the best was taken. Through repeated selective cuttings a condition was reached in which the forest contained practically nothing but defective trees or unmerchantable species."[5] Put in another way, the stand of the woodlots really represents, in the main, not merely second class species, but undesirable individuals of those species. Evidently the work of increasing the stand is of a twofold character; first an actual increase in the number of trees per acre, and, second, a change in the proportion of the species, increasing the percentage of valuable and decreasing the percentage of inferior species. In view of these conditions, which are in nowise exaggerated, it is the duty of every woodlot owner to take steps to increase the quantity and improve the quality of its stand. A half crop of poor timber is as serious a reflection upon the skill and intelligence of the owner as is a half crop of poor corn. The woodlot will never become a paying proposition until it is given proper care and cultivation.

## RE-ENFORCING THE STAND.

There are several ways in which the stand may be increased It may be by natural seed regeneration, by artificial seed regeneration, by seedlings, by cuttings or by sprouts. Whatever method is adopted, one thing is imperative, that is—that grazing animals should be kept out of the woods in which the young trees are start-

[5] Woodlot Conditions and Possibilities II: Stanley Coulter: Tenth Annual Report, State Board of Forestry, p. 127.

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ing. The present deplorable prospect for the future stand of our woodlots through the absence of seedlings of desirable species, is almost entirely due to the presence of grazing animals in the woodlot.

### NATURAL SEED REGENERATION.

In many cases natural seed regeneration will be found sufficient if the young growth is properly protected. Indeed, where stumpage values are low, it is the only method of re-enforcement possible from an economic standpoint. Under this method, seed trees of desirable species are left in the woodlot and are relied upon to furnish the new growth. It is very evident that only trees with relatively light seeds, such as ash, linden, elm and maple, can be used in this method. The seeds of such trees will under ordinary conditions cover the ground fairly thoroughly to a distance equalling one and a half to twice their height. For trees with heavy seeds, such as the oak, hickory, and walnut, this method is impracticable. The success of natural seed regeneration depends largely upon a seed year and a cutting coinciding. When a cutting is followed by a heavy seed year, the natural regeneration of light seeded species is usually sufficient to insure the future stand. If, however, a year or two intervenes between the cutting and the heavy seed year, the ground will have become compacted, the forest floor will have dried up, the soil will have lost much of its moisture, and germination will be extremely uncertain. If the soil is covered by a thick layer of "duff," natural seed regeneration will be greatly retarded, so much so in most cases, as to prove a practical failure. The seeds must come in contact with the mineral soil to insure a prompt germination and unless such exposure of mineral soil exists, natural seed regeneration will fail.

Another objection to natural seed regeneration lies in the difficulty of regulating the proportion of species. In almost every instance there will result an excess of light-seeded species and a deficiency of heavy-seeded species. This lack of control over the proportion of species is a serious objection to natural seed regeneration when the re-enforcement of woodlots is undertaken. In large areas, where the stand is still fairly dense, or in areas bordered by forests, natural seed regeneration will prove satisfactory. In woodlot conditions, with the limited area, the light stand and the cleared land surrounding, natural seed regeneration is of doubtful value. It is questionable whether it is at all applicable in Indiana in the average woodlot. In the hill regions, however, it must be relied upon as the best method under existing conditions.

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### ARTIFICIAL SEED REGENERATION.

In this method instead of relying upon the natural seed distribution to restock the area, planting is resorted to by the landowner. This planting can be easily done by loosening the earth with a pointed stick or some tool, dropping the seed into the hole thus made and gently "firming" the earth by pressure with foot. This process is known as "dibbling." There is no antecedent preparation of the ground, no attempt to plant in rows, merely a utilization of the open spaces in the woodlot. The seeds used in this work should, as a rule, have been collected from healthy, well-shaped and vigorous trees of suitable age growing in the immediate region. Such seeds have a good ancestry and are already adapted to the conditions of the locality. The seeds should be plump, of good color and of standard weight. Seeds which have been collected for over a year should be avoided, since tree seeds lose their germinative power quite rapidly. Care should also be taken not to plant too deeply. For the larger seeds an inch to an inch and a half is ample, while for the smaller seeds the slightest possible covering of earth is the best practice. No method of increasing the density of the stand is so economical or gives such satisfactory results. It has been used for years by Dr. Schenck in the great Biltmore forests, and is practiced to a greater or less extent by every successful forest manager. Where the re-enforcement of the woodlot is undertaken through seed regeneration, it is the ideal method. It is economical both from the standpoint of time and money; replanting in spots where the seeds fail to germinate is simple and inexpensive; it gives absolute control of the proportion of species in the future stand, thus insuring the highest returns; it presents fewer chances of failure than any other method.

### THE NUMBER OF SEEDS TO PLANT.

Tree seeds as a rule have a low germination per cent. They run from about ten per cent. in the tulip tree or yellow poplar to seventy or eighty per cent. in the oaks and hickories. The number of seeds to plant in an opening is determined by this percentage. In the case of oaks, hickories, walnuts and similar forms from three to five in an opening is good practice. If too many come up in any place, the young seedlings can be easily lifted and transplanted to places where germination failed. It is much easier and cheaper to thin than to replant. In the case of the lighter seed a half dozen or more in an opening will give satisfactory results.

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## WHEN TO PLANT.

Most tree seeds need a resting period before they will germinate. The exceptions to this are the maples and elms setting seed in the early summer. These should be planted as soon as they mature. The white oak also requires planting as soon after collection as is possible since it needs no resting period and cannot be safely carried through the winter. The remaining seeds must be planted in the spring. This means of course that they must be carried through the winter in such a way as not to injure their germinating power. A fairly simple, yet thoroughly satisfactory method of carrying tree seeds through the winter is as follows: Take a box of any convenient size, put in a layer of sand or leaf mold, then a layer of seeds, then another layer of sand and so on until the box is full; cover the top with straw or leaves to prevent evaporation and to protect against sudden temperature changes. Set the box in a cool, dry place, keeping the soil moist but not wet. Examine from time to time to see that the seeds do not become moldy or dry out. In the case of the large seeds the soil and seed layers should be from four to six inches deep; in the case of the smaller seeds from two to three inches. Planting should be done as soon as the ground can be worked. Since the germination period of tree seeds ranges from three weeks to as many months there is little danger of planting too early.

## RE-ENFORCEMENT BY SEEDLINGS.

Where more rapid results are desired, re-enforcement may be by means of seedlings, instead of seeds. This method involves more labor, more expense and more chances of failure. Apart from these features, it possesses all the advantages of artificial seeding, with the additional merit of quicker returns. The initial expense is greater, but time is saved. Successful re-enforcement by means of seedlings is determined by the close observance of the following rules:

1. In lifting the seedling, remove as much of the root system as is possible, using particular care to avoid injuring the finer roots.

2. Do not allow the roots to be exposed to the action of the sun or wind for even a minute. If the delicate root hairs dry out they become functionless.

3. Do not set too deeply. Plant in such a way that when the earth has settled, the seedling will be approximately in its original position.

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4. Keep weeds, especially grass, from the immediate neighborhood of the seedlings for the first year or two in order to give it a chance in its new location.

Handling of seedlings is neither difficult nor uncertain if these rules are carefully followed. The greater number of failures in re-enforcing by means of seedlings are to be referred either to allowing the root-hairs to become dry, or to planting too deeply. Whether the seedlings are taken from adjoining woods or bought from nurserymen they should be carefully inspected before planting. A straight, vigorous stem, healthy and fresh buds, a compact root system with abundant fibrous roots are the external signs of seedlings which may be expected to give a satisfactory growth. Planting should be done whenever possible in the spring at as early a date as the ground can be worked. Spring planting is universally safer under Indiana conditions than fall planting.

In using seedlings in re-enforcement, the "spot method" is perhaps the simplest and most economical. The soil is loosened to a depth of about eighteen inches in a spot about the same dimensions each way, the seedling is placed in proper position and the earth firmed about it. Under ordinary woodlot conditions in the State a man can plant from five to seven hundred trees a day. There is no antecedent preparation of the ground, no attempt to plant in rows, since the purpose is merely to make the woodlot carry a heavier load of timber through the utilization of unoccupied spaces. Experience has shown that in this, seedlings ranging from eighteen to twenty-four inches in height are more uniformly satisfactory than any others. Those less than eighteen inches in length are usually weak or slow growers and therefore unsatisfactory, while with the increase in size there is a marked increase in the risks of transplanting, in the initial cost of the seedlings, and in the labor and cost of planting.

### THE COPPICE METHOD.

This method takes advantage of the fact that a very large proportion of our hard wood trees sprout vigorously and persistently from the stump. A very large proportion of our second growth forests are sprout forests. It is applicable only where small sized stuff through quick rotations is the end sought, since sprout trees rarely grow as large as do trees originating from seed. As, however, the raising of saw timber involves very long periods, it is probable that our woodlots will be handled more frequently by the sprout method than any other. In order to insure vigorous and

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healthy sprouts the trees from which reproduction is expected should be cut in the late fall or winter. Indeed, the best results are secured if the cutting is done just before the growth starts in the spring. A reference to the extended experiments upon the State Reservation in the coppicing of catalpa is a sufficient verification of this statement.

These experiments also showed that the best results were obtained when the stump was cut as close to the ground as possible. Such stumps gave fewer, but much more rapidly growing and vigorous sprouts than those cut higher. A moment's consideration shows that to prevent decay or other infection the cut should be made in such a way that moisture will not gather upon it. A smooth surface with a single or double slope fulfills this condition

This method has the advantage of simplicity, it calls for but little after treatment, merely the selection of the sprout to be retained and the removal of the others, and is applicable to practically all of our hardwood species. It is probable that the coppice method might not prove entirely satisfactory in the northern counties of the State because of the severe winters. Re-enforcement by seeds or seedlings would doubtless be found more uniformly successful in this part of the State.

### SELECTION OF SPECIES FOR RE-ENFORCING.

Only species which have an economic value, are of easy and fairly certain propagation, are rapid growers, are naturally resistant to insect and fungus attacks should be used in re-enforcing wood lots. Out of a list of trees possessing these qualities the woodlot owner should select two or three for his work. As different species require different methods of treatment, it is unwise to undertake the handling of a large number of kinds. As a rule, expert advice concerning suitable species should be sought before the work is undertaken. This can be obtained without charge by addressing the Secretary of the State Board of Forestry at Indianapolis. In some cases, it would be wise for the woodlot owner to visit the State Reservation and determine the selection of the species which he desires to use, after a study of the experimental demonstration plats. This would give him, also, a clear notion of the relative value of different methods of handling the trees, of the cost and of the provable rate of growth, points of extreme importance in the selection of species for re-enforcement. The list of trees suitable for this purpose under Indiana conditions is not large and full information

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as to the suitability of given species for a specific locality is easily obtained. It must be remembered that success in increasing the density of the stand and improving the proportion of the species in woodlots, depends more upon a wise choice of the forms to be used than upon any one factor. It is assumed that native hardwood trees will be used for this purpose. Any attempt to re-enforce with exotics or conifers would surely fail, yet such attempts are often made under the influence of the persuasive eloquence of the tree agent. Of our native trees, white ash, yellow poplar, white elm, walnut and red oak are particularly promising, where soil and exposure conditions are favorable. It is the determination of this point that requires expert advice. Many failures in re-enforcing operations in the past are attributable to the lack of specific recommendation of certain species as suitable for the work. No species is suitable for all localities and in a very real sense the problem of selection of species for re-enforcing is a local one, to be solved by a study of local conditions.

## SUMMARY.

In increasing the quantity and quality of the timber carried by our woodlots, the immediate work of the woodlot owner lies along the following lines:

1. Distinguishing clearly between the *woodlot* and the *wood-pasture,* giving to the woodlot the necessary conditions for its growth and development.

2. A recognition of the characteristics of a good woodlot as shown both in its positive and negative characters.

3. An attempt to bring the present stand into these conditions by gradual improvement cuttings, which shall remove fungus and insect infested forms, misshapen trees and undesirable species.

4. To increase the density of the stand by causing new trees to start by some method adapted to the special conditions of his woodlot.

5. A careful selection of species under expert advice for the work of re-enforcement.

6. Persistent and intelligent effort along these lines until the desired result is secured.

7. To keep as his ideal of the woodlot one which carries the largest number of the best trees in proper proportions, and which reproduce themselves most rapidly and more surely.

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# Preliminary Studies in the Rate of Growth of White Ash (Fraxinus americana L.) in Indiana.

BY STANLEY COULTER, PH. D., DEAN OF SCHOOL OF SCIENCE, DIRECTOR OF LABORATORY, PURDUE UNIVERSITY.

The results of the studies on the rate of growth of certain species of native trees upon the Indiana State Forest Reservation, reported last year,[1] were so suggestive that it was determined to extend the studies so as to include typical regions throughout the State. It will be recalled that upon the State Reservation the topography is broken, with elevations ranging from 500 to 1,000 feet above sea-level. That the soil of the tract varies from a loose to a compact clay, which, though receiving the usual rainfall for the State is usually hard and dry, in part because of the character of the soil and in part because of the extremely rapid run-off. It was recognized in the report cited that growth studies gave results which were essentially regional in their application and that until fuller studies were made no conclusions could be drawn which could be considered as giving a fair idea of the rate of tree growth in the State as a whole.

It was thought best that the present study should be more intensive in its character and the work here summarized is confined to a single species. The original plan contemplated the collection of twenty-five disks from each of eight regions, which were considered as typical of practically all conditions existing in the State. Unfortunately the lack of funds prevented the carrying out of the plan in its entirety and the results set out in this paper are to be regarded merely as a part of a more comprehensive study which it is hoped to complete during the present year.

The species selected was the American white ash. The reasons leading to this choice were, its wide range of uses,[2] the fact that it becomes merchantable at a less diameter than almost any other

[1] The Rate of Growth of Certain Species of Native Trees on the State Reservation. Stanley Coulter. Eleventh Annual Report, State Board of Forestry, 1911. pp. 67-85.

[2] Reports from 549 establishments in eighty-six counties of the State show that in 1910, approximately 7 per cent. of the material used was white ash, amounting in round numbers to nineteen and three-quarters millions board feet.



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hardwood species and its high promise as a suitable species for reforestration or for re-enforcing existing woodlots as shown by its behavior in the experimental work at the State Reservation.

Two collections were made, the field notes being taken by Forester Deam, a fact which insures both their accuracy and completeness. One series of twenty-seven disks was collected on the farm of Clarence Griffith, Section 34, Jackson Township, Wells County. The second series of twenty-eight disks was taken from the farm of David House in Hamilton County, seven miles south from the city of Elwood. In both cases the ash was being cut by handle manufacturers, thus furnishing an exceptional opportunity for the collection of material. The disks were cut three inches thick and were taken just after a fifty-eight inch bolt was cut. As the stumps were left from ten to twelve inches high, the diameter measures are at approximately six feet instead of at breast-height or four and one-half feet. This has been taken into account in the following data, five years being allowed in each case. To any one at all familiar with the growth of white ash it is evident that this is an ample allowance.

The average diameter was secured from several measurements, and a radius representing this average was selected. The counting and measurements were extremely carefully done by Mr. P. H. Teal, a student in Forestry at Purdue University, and may be thoroughly relied upon. The decades were marked upon the selected radius and measured to one-tenth of an inch. The count was made from the center outward, the fractional decades thus being at the periphery. This departure from the method adopted by the U. S. Forestry Service was made, since for the purpose of this study the growth rate in the earlier decades was felt to be of great significance and that by this method results would be more easily comparable. The counting and measurement was, wherever at all doubtful, verified by a recount. A magnifier was used in many cases, both for the count and measurements. The disks from which these studies were made are in the forestry museum at Purdue University.

In the Wells County tract the soil was a black loam, the land being low and very flat. In the Hamilton County tract the soil was also a black loam and the land was low, sloping slightly toward the west where a pond probably formerly existed, the prevailing trees being soft maple and black ash. Apparently the only appreciable soil difference between the two tracts is to be found in the better drainage of the Hamilton County land.

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The associated trees in the two tracts were practically the same, the prevailing forms in both being white ash, white, red and burr oak, sugar maple, shellbark and black hickory, black and Biltmore ash and black cherry. Those found in Wells County only were green ash (Fraxinus lanceolata) American elm, swamp white oak, beech, pignut hickory and sycamore. Those found in Hamilton County only, were red elm, coffee-nut, tulip tree, linden and black walnut. As the associated trees were limited to a radius of fifty feet from the trees from which the specimen was taken, these differences are more apparent than real. The composition of the forests of the two counties is practically identical.

Because of long continued grazing there was no characteristic undergrowth in either area. Attention has been called thus fully to the great similarity of the tracts, save in the matter of drainage, because of the difference in the growth rate in the case of the ash and in the average diameter of the associated trees.

In the measurements of the twenty-seven disks taken in Wells County, the average annual growth was found to be .118 inches; that is, the tree at one hundred years of age would be 11.8 inches in diameter, at four and one-half feet from the ground. In the Hamilton County tract, the measurements of twenty-eight disks showed the average annual growth to be .136 inches; that is, a tree one hundred years old would be 13.6 inches in diameter, four and one-half feet from the ground, a difference of one and four-fifths inches.

An examination of the associated trees is interesting in this connection. The following table presents the differences in a concise form, considering only the species common to both counties:

| Species. | Average Diameter in Inches. | |
|---|---|---|
| | Wells County. | Hamilton County. |
| Fraxinus americana | 12.2 | 14.4 |
| Quercus alba | 12.6 | 19.5 |
| Quercus rubra | 15.9 | 18.5 |
| Acer saccharum | 10.6 | 12.9 |
| Hicoria ovata | 9.3 | 14.4 |
| Hicoria cordiformis | 9.7 | 14.9 |
| Fraxinus nigra | 11.6 | 12.1 |
| Quercus macrocarpa | 14.7 | 23. |
| Fraxinus biltmoreana | 15.2 | 12.5 |
| Padus serotina | 7.5 | 13.6 |

It is, of course, not intimated that such differences would exist if all of the trees in the two tracts had been measured, it is merely suggested that the more rapid growth rate of the ash in the particular tract under consideration is correlated with a greater average

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diameter of associated species. While it is possible that this may have arisen in part from other causes, it is evident that drainage is an important factor in determining the growth rate of forest trees.

Associated with the greater diameter growth rate of the ash in the Hamilton County woods, was a greater height growth. The average height of the twenty-seven trees cut in Wells County was seventy-five feet and eight inches; of the twenty-eight Hamilton County trees, it was eighty-one feet and four inches. Without going into the details, the growth charts also indicate that the Hamilton County trees showed a greater clear bole and a greater amount of utilizable material. This fact, also, serves to emphasize the importance of drainage as a factor in determining growth rate.

The soil, however, is also a factor of high importance. It will be recalled that the soil upon the State Reservation is a clay, varying from loose to compact and with good, if not indeed excessive drainage. The ten trees studies from that region gave an average annual diameter increase of one-tenth of an inch; that is, one hundred and twenty years would be required for a tree to reach a diameter of one foot at breast height. The average height of the trees was sixty-eight feet and nine inches.[3]

It is a fair inference from these facts, that within our area, the white ash makes its most rapid and vigorous growth in loamy soils with good drainage; that it will thrive, but grows less rapidly in loamy soils with poor drainage, and that it will maintain itself in clay soils with good drainage, although in the latter case the growth rate will be relatively slow.

It is difficult to determine the period of most rapid growth. In the studies from the State Reservation, it was in almost any decade from the first to the tenth; in the Hamilton County tract it was in a large majority of cases in the fifth and sixth decades; in Wells County in an equally large majority of cases it was in the eighth and ninth decades. The white ash needs shade in the earlier growth, but later demands full sunlight. It will, however, stand suppression for a long time, and after the cover is removed make an astonishingly rapid growth. The following will illustrate this fact, the diameter increase for each decade being given in inches:

| No. of Specimen. | 1st. | 2nd. | 3rd. | 4th. | 5th. | 6th. | 7th. | 8th. | 9th. | 10th. | 11th. | 12th. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | .56 | .32 | .26 | .32 | .76 | .94 | .76 | 1.52 | 1.6 | 2.38 | ..... | ..... |
| 3 | .54 | .66 | .70 | .86 | .90 | .66 | 1.14 | 1.22 | 1.78 | 2.9 | ..... | ..... |
| 5 | .68 | .44 | .30 | .30 | .42 | .54 | .92 | 1.66 | 3.26 | 3.76 | ..... | ..... |
| 21 | .54 | .48 | .50 | .82 | .86 | .88 | 1.14 | 1.2 | 2.64 | 2.4 | 1.14 | .92 |

[3] Eleventh Annual Report of the State Board of Forestry, 1911. pp. 71-78.

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It will be noted in number five, that much more than one-half of the total growth occurred in the eighth and ninth decades. A careful study of the series of charts indicates a fairly uniform rate of growth for the first four decades, with a sharp increase in the fifth and sixth, followed by a fairly rapid decline in the subsequent decades. Where the period of most rapid growth occurs as late as the eighth, ninth and tenth decades, it is in all probability due to suppression because of the shade of older trees. This prompt recovery from such a long period of suppression is somewhat surprising, but it seems to be born out by the data without much room for doubt.

The diameter increase in the first decade was far from uniform, a fact somewhat surprising in such small areas, where the conditions were practically identical. In the Wells County area this ranged from four-tenths of an inch to one inch and seven-tenths. Taking the average for the twenty-seven trees, for the first decade we have a trifle over eight-tenths of an inch. In the Hamilton County tract the range of growth for the first decade was from thirty-four hundredths of an inch to one and one-half inches, with an average of a trifle under seven-tenths of an inch. It is probable that in fairly good soils the white ash in forest conditions reaches a diameter of about an inch in the first ten years. In the successive years it grows more and more rapidly, culminating at from fifty to sixty years, after which the growth rate declines, at first somewhat gradually, but later quite rapidly.

No definite relation could be found to exist between diameter and height from the material studied. Twenty-five of the trees ranged from fourteen to fifteen inches in diameter. As might have been expected, this group had a greater height than in the case of the sixteen trees which were below fourteen inches in diameter; what was not expected was that they also showed a greater average height than the fourteen trees which ranged from fifteen and one-half to seventeen and one-half inches in diameter. Of the fifty-five trees, four were over ninety feet high, nineteen between eighty and ninety feet, and twenty-five between seventy and eighty feet.

It is evident that to grow saw-timber, that is trees a foot in diameter, takes time under ordinary forest conditions. Ash trees of that diameter, will in all probability, range from eighty to ninety feet in height and will vary in age from about ninety years in well-drained, loam soils, to one-hundred and twenty years in dry clay soils.

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The studies of W. D. Sterrett of the department of silvics of the U. S. Forest Service, show a somewhat more rapid growth rate in certain other States. It is of course possible that within our area there may be found localities where this will occur, but under forest conditions as they exist in Indiana at present these figures are more likely to be reduced than increased.

There is little doubt that under proper silvicultural methods the rate of growth of native trees may be greatly increased. It would be somewhat surprising, judging from the results in the case of other plant forms, if the rate of growth could not be doubled by the application of proper methods. In the case of the ash, this would mean growing trees a foot in diameter, with a clear bole of approximately forty-feet in fifty years. The white ash responds quickly and certainly to cultural methods as is shown by the results on the experimental plats at the State Reservation. Further, it is as yet singularly free from insect and fungus attack and grows a clean, straight trunk if given a fair chance.

In using this species for planting or for re-enforcing existing woodlots, the following facts should be kept in mind:

1. While capable of maintaining itself on a wide range of soils, white ash gives the most rapid and vigorous growth in well drained, rather loose loam soils.

2. That during the earlier years shade is needed if the trees make their most vigorous growth.

3. That later a full light is demanded.

If these facts are kept in mind there is no tree of greater promise within our area, either for purposes of reforestation or for re-enforcement. Failure to observe these conditions may not, in all probability result in complete failure, but will without doubt result in disappointment in the rapidity of growth.

It has not been thought necessary to include the growth charts in this paper since they will be included in the complete study which it is expected to complete for the next report. They are, however, available for examination, as are also the disks and accompanying data sheets, in the forestry laboratories of Purdue University.

The studies have progressed sufficiently to justify the recommendation of the white ash as an extremely desirable species for woodlot planting and encouragement.

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# Shade Trees.

BY CHAS. C. DEAM, SECRETARY.

Shade trees are not a rich man's luxury, they are a public necessity. They have an aesthetic and ornamental, an economic and an educational value. These values are so closely related that it is difficult to pro-rate them. Undoubtedly the tree planted along a street or roadside, which serves the greatest number of people, has the greatest economic value. The tree planted in a lawn or park, whose function is to modify the landscape, is commonly called an ornamental tree. It should not be considered as an individual but as a part of a whole. Its function primarily is to complete a conception of unity.

The value of a shade tree is usually considered only in its relation to satisfying our physical comforts, while to its beauty is assigned relatively little value. It is believed, however, that our idea of these values should be reversed, because the greatest ultimate good may come, through the aesthetic appreciation.

## Aesthetic and Ornamental Value.

The aesthetic value of a tree or number of trees cannot be expressed in any definite term. Beauty is an abstract conception, which in the ultimate, like units of force, is incapable of analysis. It is a true quality of things, appreciable by a mode of perception and perfectly real to the perceiver but indefinable. The principles that seem to explain it are those of harmony, design and adaptation of means to an end.

Aesthetic pleasures are those feelings that come to us through our perception of beauty in art, literature, human character and nature. Our indulgence in such aesthetic feelings contributes to our happiness and elevates the tide of life. Some people in their mad rush for wealth have dulled their aesthetic appreciation by neglect, but we are grateful that many have kept their altars burning with good thoughts and helpful deeds.

The beauty that can be developed by the use of shade trees is one that should not be neglected. It has an economic value and people are paying money for it, as shown in the advanced price



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commanded by city property that possesses beautiful trees. It is a value not appreciated by many and one that is enhanced by education. It is believed a sentiment can be created in favor of the planting and care of trees along streets and highways and people be educated to an appreciation of them.

The soul of man responds to the fragrant blossoms, the panorama of color, the soughing branches and the stately form of trees. He is moved by the chorus of bird forms domiciled in their branches. The most hopeful sign of the prevalence of a sentiment in favor of trees is the frequent expression of resentment at the dehorning of trees by so called tree pruners and their mutilation by so called public utility companies. Our education must be a two-edged sword. It must compel some people to plant trees and prevent others from destroying them.

The annual or biennial celebration of Arbor Day has apparently accomplished but little. The idea is a good one and furnishes a basis for attacking the problem. Arbor Day as it is generally observed is a gala half holiday and little is done on the day or previous to the celebration to fix the idea of the value of the planting and care of trees. Since our lives are so intimately spent with trees and we owe so much to them, every teacher is justified in spending some time in acquainting his pupils with the trees and their value. In fact, he is under moral obligations to do so. The love and appreciation of trees is latent in every child and the teacher should see that it is given expression. It is not enough that in the school yard there should be planted a few trees and shrubs, too often improperly selected. Every schoolhouse should be surrounded by a carefully selected lot of trees, shrubs and vines. These should be cultivated, cared for and protected. Every school should have its school garden where lessons in agriculture and forestry could be demonstrated. The children would be intensely interested in them. They would cost little or nothing. Why do they not have them? Is it because the teacher is ignorant of the subject? When the children in the schools are taught to thoroughly understand the value of shade trees, the problem will be solved. Then the streets and highways will be lined with thrifty and well-chosen trees. Then the miscellaneous collection of trees which adorn our cities will give way to avenues of well-selected trees. Then the crippled and mutilated trees will be replaced by others that will never know the oldtime "tree pruner." Then the telephone lineman will not dare to cut a hole through the crown of a tree, or a merchant disfigure it with signs.

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In the meantime, other measures must be adopted to take care of the present situation. Recently the women's clubs and civic federations have taken up the subject and much good is expected from these sources. There are state laws and city ordinances which if enforced would in a great measure secure the desired end.

## ECONOMIC VALUE.

The economic value of shade trees may be considered as follows:

First. They are planted primarily for protection from the sun. They, also protect man, animals and buildings from rain, snow, wind and storm.

Second. Shade trees have a hygienic and sanitary value. They absorb obnoxious gases and throw off oxygen. Their roots penetrate the earth deeply, furnishing better drainage conditions.

Third. They enhance the value of the property on which they are planted, and in a measure, that of adjoining property. There are court decisions which show that single trees have been valued at hundreds of dollars.

Fourth. The appearance of a city is one of its assets. By improving the appearance of a city, a civic patriotism is engendered, which makes for progress. It is also known that the morals of a community are in direct relation to its environment.

## EDUCATIONAL VALUE.

Forests are becoming so scarce and far removed that children who live in the cities learn much of the life history of trees from those that grow in the cities. This fact is a strong argument in favor of cities owning parks. The botanic interest and value of parks is, as a rule, underestimated. This assertion may be verified by questioning the city school teachers. In order to make the park of the most educational value it is suggested that as many species of the local trees, shrubs and vines as possible be planted. Those of foreign origin should be selected with the idea of showing different foliage, flowers, fruits, etc. It is variety, not uniformity, that pleases.

## THE LOCATION OF SHADE TREES.

Trees planted along streets and highways meet different conditions and a brief discussion of each location follows:

*Street Trees.*—The position of trees along a street is determined primarily by the location of the sidewalk. If a parking space of sufficient width intervenes between the street and walk,

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the trees are planted in this space. If the walk abuts the curb the trees are planted near the property line, and it is suggested at a distance of four to six feet from the walk.

Some of the advantages of placing the walk next to the curb line and planting the trees on the lawn-side of the walk are as follows:

(1) The tree in this position can not be used as a hitching post or be injured by vehicles.

(2) The root system is cut off in one direction only which makes more favorable conditions for the long life and rapid growth of the tree than if the feeding roots should meet barriers in two or more directions.

(3) When a parking space intervenes between the walk and curb, a line of drain tile follows the outer edge of the walk and along the curb. Trees planted in a ten-foot parking space would have a row of drain tile within five feet of each side of the tree. Trees planted in the lawn would have a drain tile on one side only, and that at a distance of four to six feet and on the side opposite from which the tree would receive its greatest supply of moisture.

(4) Trees in the lawn would be less liable to be injured by gas escaping from gas mains. The trees would be farther away from the gas and water lines, the frequent repair of which is continually disturbing the root system of the trees.

(5) The top or crown would be farther removed from the network of wires which is usually along the curb line.

(6) The trees would be farther from the reflected heat of the walk and street, and such trees as the linden, which suffers seriously from this cause, could be more successfully grown.

(7) The tree would be far enough removed from the driveway that overhanging branches would not obstruct the view and thus accidents would be everted. This is especially true of narrow streets at night where the crowns of the two rows of trees almost touch each other. When this condition exists the light of the street lamps extends but a short distance beyond the street intersections and an approaching vehicle can not be seen in the darkness.

(8) The trees being in the lawn the owner has a better opportunity to enjoy their shade by being able to place his chair, or hammock, under them. Then, too, the trees will usually be close enough to the house to protect it from the sun.

(9) When the walk is along the curb, expectorations will be cast into the gutter, which is a sanitary argument in favor of making the walk next to the street.

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The principal objections to locating the walk next to the curb line and planting the trees in the lawn may be given as follows:

(1) Pedestrians are in more danger from passing vehicles and possibly from a falling live wire.

(2) That the trees are located so near the house as to cause it to decay. This objection vanishes at once if the house is located the proper distance from the walk. It is a common error to build houses whose porches extend to within ten to fifteen feet of the walk. This makes the home less private and deprives the occupant of a lawn which may be ornamented with flowers and shrubs. A residence built near the walk loses in architectural effect and reminds one of a tenement. It is believed this crowding of the dwelling toward the walk is the result of a desire to have a roomy back yard which may be used for a garden and chicken park.

(3) That the driveway is not shaded enough.

*Highway Trees.*—Trees have not as yet been planted along the highways to any extent in this State. The sentiment in favor of it is fast growing and many more trees would now be planted if owners had the assurance that telephone linemen would not mutilate the trees, merchants would not disfigure them with advertisements and that they would not be otherwise injured by a careless public. It is not just to charge the average landowner with lack of appreciation of roadside trees and it is believed that as soon as he has the assurance that roadside trees will be protected, their planting along highways will be a common practice. To show what the States of Michigan and Wisconsin are doing along this line, parts of their laws relating to this subject are quoted. From the Michigan law: "Shade trees shall be planted along both sides of the public highways, at the uniform distance, as near as may be, of sixty feet apart and not less than twenty-three nor more than twenty-five feet from the center line of the highway, but the township board may direct as to the distance which trees may be set from each other or from the outer line of the highway." "Where trees are not planted and growing along the highways the highway commissioner may cause to be set out each year as many trees as he may deem advisable in his township where the adjoining lands are cleared, but shall not expend to exceed ten per centum of the road repair tax in any one year for such purpose." From the Wisconsin law: "Every person along or through whose lands any highway may pass may plant and cultivate on one or both sides thereof, where he shall own land, trees of such varieties as commonly grow at least forty feet in height, set two rods or less apart in * * * a row within

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eight feet of the outer line of the highway, * * * and when such trees shall reach twelve feet in height the superintendent of highways shall, if the same be growing thriftily, give such owner, on his request, a certificate that he accepts such trees as public shade trees. Thereafter such trees shall be public shade trees and be protected as public property, but the title thereto and to their fruit shall remain in the owner; and such owner, so long as he shall maintain such trees, replacing such as die, shall receive an annual bounty of * * * three cents for each rod of highway along which such trees are planted on one side and * * * six cents if on both sides, to be credited upon his highway taxes. For the protection of such trees while growing, such owner may, by leave of the superintendent, inclose the same by a fence." (Sec. 1344.)

Roadside trees should not be planted closer than fifty feet. The distance apart depends upon the species planted. They should never be planted on the property line, but just inside or outside of it. If planted on the inside they may be better protected, but they take up more tillable ground. If planted on the outside they are more liable to be injured, and more of the root system will be cut off by the roadside ditch.

Some of the advantages of trees along the highway are as follows:

(1) Trees along the highway add beauty to it.

(2) They protect both pedestrians and beasts of burden from the heat of the sun and afford a cool and shady resting place for both man and beast when traveling.

(3) They keep improved roads moister, thus preventing the wind from blowing away the road material. Road experts say they increase the life of gravel and stone roads in a marked degree.

(4) If the tree is protected it will in time have a commercial value.

(5) If the trees along a highway are properly spaced, their crowns make an effective windbreak, which lessens evaporation in the adjoining field and the liability of crops to be overthrown by the wind.

(6) They furnish the much needed shade for the stock pastured in adjoining fields. (See Plate 20.)

(7) They serve as an attraction and furnish nesting places for birds of economic value. The robin especially needs a nesting place since the old rail fences have disappeared. They also offer a retreat for our song birds from hawks. Our common song birds consume

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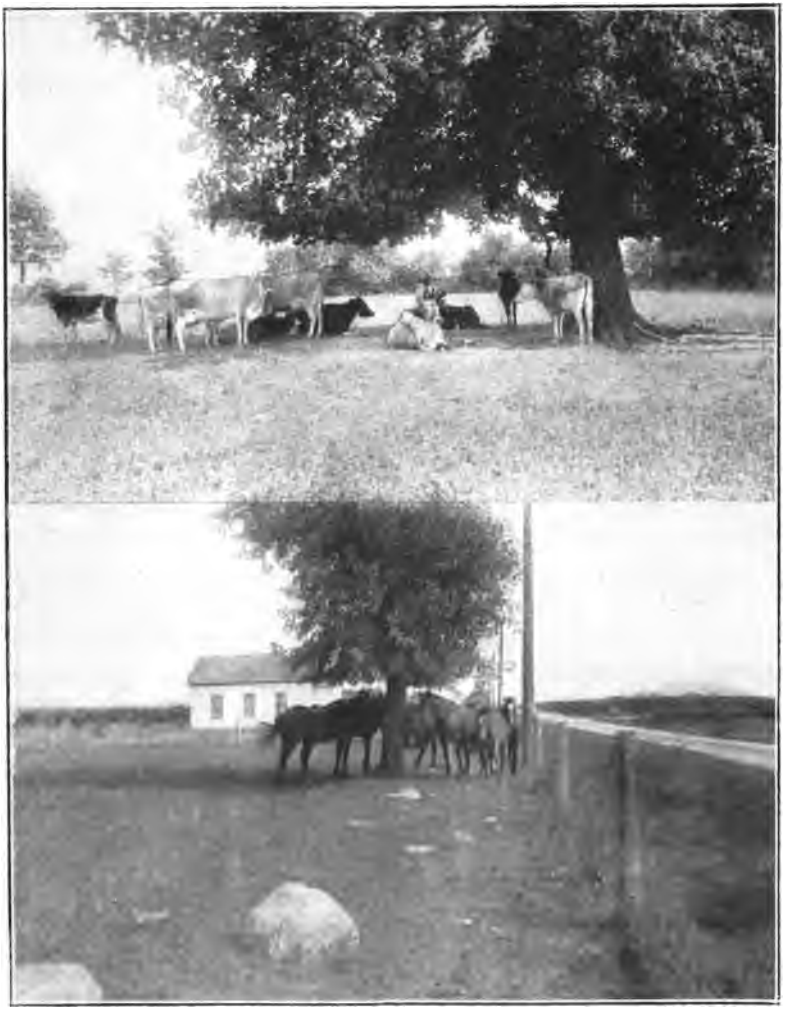

PLATE No. 20. The pasture field should have a shade tree.

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great numbers of weed seed and destroy many obnoxious insects, and thus have a high economic value.

(8) The high value placed upon them and the care given them where they have been established.

The objections to roadside trees are as follows:

(1) That their tops shade and their roots take nourishment from the adjacent crops.

(2) That they prevent the drying of unimproved roads thereby impeding travel.

(3) That they cause the snow to drift. This objection is wholly unfounded. An extended study was made last winter after two deep, drifting snows had fallen. The prevailing wind was from the west and the observation was confined to north and south roads. It was found that trees, along the roadside with branches at a reasonable height in no appreciable way caused the snow to drift. The same may also be said of the ordinary wire fence with the posts two rods apart. A board, picket or rail fence will always cause the snow to drift more or less when there is a heavy wind.

## THE SELECTION OF TREES FOR STREETS.

The selection of a street shade tree is one of the most perplexing problems of the city forester. The various species of trees demand varied conditions for their healthy growth and development. A thorough knowledge of these conditions, together with a knowledge of the species that will answer the requirements, is needed for an intelligent choice of the kind of tree to plant. A thorough knowledge of local conditions is necessary and for this reason only the most general rules can be given for guidance. The qualities required of street trees will be discussed in the order of their importance.

*Form.*—The first consideration is to choose a tree that will conform to the space available for the mature tree. Artificial pruning should not be necessary to limit the horizontal or vertical growth. The natural habit of the tree should be preserved as nearly as possible. If the space available for the crown to develop in is narrow, a small tree with a narrow crown should be chosen. If the crown is soon to meet obstacles from above, a low-growing tree should be selected. If local conditions will permit, all of the trees along a street should be of one species and as uniform in size and shape as possible. If it is not possible to have the entire street of one species,

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at least each block should have but one species. Street trees should have a straight trunk and a symmetrical crown. Uniformity intensifies and through it harmonious results may be obtained.

*Adaptability.*—The most desirable tree must have a wide range of adaptability, a strong power of resistance and the ability to maintain its vigor under unusual circumstances. It may be planted in a soil that is either dry or wet, sterile or rich, well or poorly ventilated, or subjected to excessive heat, dust, smoke or noxious gases. It should be strong enough to be not easily broken by the wind, sleet or snow. It should be able to resist frost, insect attack and disease. It should transplant well and readily recover from mechanical injury such as pruning.

*Cleanliness.*—A tree should be chosen that is as free as possible from the following objections. From the heaving up of the pavement by surface roots as by the soft maples. From suckers sent up from the roots as in the silver poplar. From the litter made by falling bark as in the sycamore. From the litter of twigs in winter and spring caused by the self-pruning of such species as the Carolina poplar. From the constant falling of leaves from early summer to fall as from the Carolina poplar. From the litter caused by falling of flowers as from the cottonwoods and catalpa. From the offensive odor of the flowers as is emitted by the staminate flowers of the ailanthus. From the litter caused by the falling of the fruit as from the catalpa, sweet gum, mulberry and sycamore. From worms falling from the trees, such as the larvæ of the catalpa sphinx and the tussock moth.

*Longevity.*—A long-lived tree is the most desirable and it is unfortunate that the most desirable trees belong to the slow-growing class. However, if shade trees received the cultivation and care they should, their growth would be comparatively rapid.

The great desire to secure a rapidly growing tree frequently outweighs all other considerations and with disastrous results. It is believed that in this State fully two-thirds of all the shade trees are Carolina poplar, box elder, catalpa and soft maples, the vagabonds of the shade tree creation. Quick-growing trees are usually short-lived. The sycamore is the most notable exception, and the elm and tulip under favorable conditions, should not be regarded as slow-growing.

*Immunity.*—All trees, except the cypress and ginkgo, are subject more or less to the attack of insects and disease. Insect pests have become so prevalent that spraying is imperative in many local-

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ities in order to have healthy trees. The spraying of trees when in foliage temporarily mars their beauty and it is quite expensive, especially when the trees are very large. A tree comparatively free from the attack of deadly insects should be preferred, but the elm and hard maple, the most desirable of all trees, are subject to the attack of the borer, the insect most difficult to control.

*Shade Production.*—A shade tree should not shade the house too much and should permit a good growth of grass beneath the tree. It should have a long leaf-period and maintain a vigorous appearance of foliage throughout the season. The most common error, where shade trees are maintained, is to grow them too close together, thus producing too dense a shade. This may be corrected by spacing the trees farther apart and raising the crown.

### DISCUSSION OF SOME AVAILABLE SPECIES FOR STREET PLANTING.

In the selection of a species it is wise to be guided by the experience of older cities of the United States and of Europe. While the number of available species runs into the hundreds, yet experience shows that our choice should be confined to not more than a dozen or two species. Local conditions and the available space for the tree should in the main govern the choice of species.

*Norway Maple.*—Along a narrow street or where the space will not admit of the use of a large tree, the Norway maple is one of the very best species to plant. Compared with its rivals, the sugar and black maples, it is more adaptable to the soil conditions and other hardships which city trees must encounter. It is also less affected by insect pests. It develops a round and compact crown. The species has a tendency to head too low, which should be corrected by pruning when the tree is small. A frequent mistake is to permit the head to form at about six feet above the ground, which is entirely too low for a street tree. (See Plate 22.) The effort to correct this mistake later results in impairment of the vitality of the tree and injures the symmetry of the crown. The leaves are larger than the sugar maple, have a deeper green color and turn a light yellow in the fall.

*Sugar or Hard Maple.*—In appearance this species resembles the Norway maple, but grows to a larger size. When the conditions of growth are not too exacting it should be regarded as the best species to plant. It is sensibly affected by paved streets and by conditions which limit its root system. The tree develops numerous branches which have a pleasing effect in the winter condition. It is clean in

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habit and long-lived. The foliage during the summer is a pleasing shade of green, which in the autumn turns to gorgeous tints of orange, yellow, red and brown. In the autumnal coloring of its foliage it is exceeded by few, if any, of our trees.

*Black Maple.*—This species is not usually separated from the sugar maple, which in size and form it resembles. It is adapted to a moister soil and has a darker and smoother bark, resembling that of the Norway maple. Its leaves are larger and a darker green than those of the sugar maple. The sides of the leaves droop and are a yellow-green beneath.

*White Elm.*—The "elm" as it is popularly called is a large tree and adapted to wide streets. It is beautiful throughout the year. It is hardy and long-lived; easily propagated, of rapid growth and clean habit; adapted to wet, moist and fairly dry soils; grows tall, is stately and graceful; it is very variable in form, usually developing a vase-shaped crown; its leaves appear early in the spring and remain until late in the fall.

It is unfortunate that the elm has a few deadly insect enemies. The elm-leaf beetle and cottony maple scale are the worst, but where provision is made for spraying these may be kept in check.

The English, the Scotch, and the red or slippery elms which are often planted, have no advantage over the white elm as street trees. They may well be planted in parks and other situations where variety is an object.

*Pin Oak* (Quercus palustris).—This tree is adapted to a moist soil, grows rapidly after it has been transplanted a few years, branches profusely, the lower branches being pendant, the upper horizontal or slightly ascending, forming a crown usually pyramidal in outline; the leaves are a bright green, deeply and unsymmetrically lobed, producing a dense shade, usually passing through many tints of red in autumn. It is the most extensively used of the oaks for shade tree planting. It is to be regretted that the oaks have not been more generally used for this purpose. The oaks develop a tap root system which is broken when young trees are transplanted from the woods. This retards their growth and has given rise to the prejudice against the oaks that they are slow growers. If nursery grown trees which have been transplanted several times are planted it will be found that they will grow as fast as other hard wood species. The pin oak has no deadly insect pest, a fact which strongly recommends it. It is sometimes attacked by an insect gall which detracts from its winter appearance but rarely kills the tree.

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*Scarlet Oak* (Quercus coccinea).—This species is adapted to a dry soil, grows rapidly, develops an oval or a spreading crown and has leaves similar to those of the pin oak but with a brighter autumnal coloring, which has given it its common name. This form is growing in favor and time may demonstrate its superiority over other oaks.

*Red Oak* (Quercus rubra).—This tree prefers a moist soil, although it adapts itself very well to a dry soil; it grows rapidly;

FIG. 4. A row of Sycamore on East Tenth Street, Indianapolis, Ind.

soon loses its lower side branches and develops an oval head, often with large spreading branches. The leaves are larger than those of the two preceding species, and are a glossy green, which in autumn mature with a rich coloring of red.

*Sycamore.*—The sycamore prefers a rich, moist soil, but adapts itself to all kinds of soils; it transplants easily; grows rapidly; develops an oval crown, sometimes with large ascending branches; its leaves are attractive in shape and are large but do not form a dense shade; the trunk and branches have a picturesque, mottled green and gray color due to the flaking off of the bark. It is from

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this habit of shedding its bark that some people object to this tree. This objection may to a great extent be relieved by occasionally scraping off the loose bark with a scraper tied to a cane pole. The labor and cost entailed in keeping the trunk clean would be nothing compared to the expense of spraying, which is necessary for a majority of trees. The sycamore is practically free from insects and in only a few localities is it attacked by the leaf fungus to any damaging degree. The sycamore stands pruning well and some trees have been seen which had the terminal cut when the trees were about twenty feet high and the crown developed from this point. Wounds heal readily and the crown may be trained to please the fancy. The sycamore has been used extensively in Martinsville, New Albany and Jeffersonville. (Fig. 4.)

The Oriental plane which resembles our sycamore has been extensively planted because of the belief that it was free from the leaf fungus. A leading nurseryman of Indiana is authority for the statement that the reverse is true and advises the use of the sycamore.

*Biltmore Ash.*—This ash grows rapidly, tall and to be a rather large tree. It is adapted to a moist or dry soil, transplants successfully and develops an open, pyramidal or oval crown; the leaves appear late but remain on until the last of September; it is clean in habit, bears pruning well and is not seriously affected either by insects or fungi. It differs from the white ash, which it the most resembles, in that the bark has deeper and longer fissures; that the last year's growth is hairy and the leaves generally have nine instead of seven leaflets. The leaflets are a shade darker than the white ash, thicker, more glossy, and in autumn they mature with a tinge of purple and red. The tree is much prettier than the white or green ash and persons desiring to plant ash should see that they get the genuine Biltmore ash. It is a native of Indiana and is locally known as the "old fashioned or deep forest" ash. It is best to buy the trees from an Indiana nurseryman who has grown his trees from seed collected in Indiana. All nurserymen do not separate the white, Biltmore and green ash, so it is necessary to insist upon getting the right species. The green ash has been planted more frequently than the other species. It is a smaller tree when it matures. The fissures of the bark are shorter and not so deep as in the case of the white or Biltmore ashes. Both the white and green ash as a rule shed their leaves a week or so before the Biltmore ash. The foliage of the green ash does not exhibit the autumnal colorings of the Biltmore ash.

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*Liquidambar or Sweet Gum.*—This species grows to be a large tree. It is adapted to a moist soil and is difficult to transplant. The natural habit of the tree is to grow tall and narrow, but when grown in the open it usually assumes the outline of the sugar maple. At a distance it is often difficult to distinguish it from the maple on account of the similarity of the shape of the leaf and outline of the tree. The glossy green color of the foliage, which in autumn changes to tints of red, purple, yellow and brown, makes it quite ornamental. It is practically free from insect enemies.

*Black Gum.*—This tree is found throughout Indiana and is locally variously called gum, black gum, sour gum and pepperidge. It is a large tree, grows slowly and is long-lived. It prefers a moist soil, but thrives in dry soil and under adverse conditions. It has numerous horizontal branches, the lower somewhat pendant. When grown in the open it usually develops a symmetrical crown, long pyramidal in outline. Its foliage is a glossy green, which in autumn turns to all tints of orange and red. The richness of its autumnal foliage is not surpassed by any other tree. It is free from insect and fungous pests. There are many instances in which this tree has been used with great success for ornamental purposes and I see no reason why it should not be used for street planting.

*Ginkgo.*—This is an imported tree and has as yet been but little used as a street tree. Experience with it, however, suggests that it is one of the very best to plant, especially where there are narrow streets. It grows rapidly after it secures a start, adapts itself to all soils and develops a narrow-pyramidal or narrow-oval crown. The leaves are fan-shaped with straight veins, reminding one of the maiden-hair fern, hence its common name the "maiden-hair tree." The foliage is a bright green, which turns a golden yellow before it falls. It is entirely free from insect and fungous pests, which strongly recommends it.

*Cypress.*—This tree is native only to the southwestern part of the State. It has been used but little as an ornamental or street tree. It is not yet known whether it would be hardy in all parts of the State or not. Plate 21 is a photograph of a cypress in a lawn near the street in Greencastle, Ind. This tree is 99 inches in circumference breast-high. As near as it was possible to ascertain its age it is between fifty and sixty years. There is a good example in Mt. Carmel, Ill., of its use as a street tree, and that too on high ground. It naturally grows in swamps but when transplanted adapts itself to drier conditions. It grows rapidly, the branches are horizontal and the crown pyramidal. The tree has the appear-

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PLATE No. 21. Cypress tree in a lawn in Greencastle, Ind.

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ance of a gigantic fern. The leaves are very small, a blue-green when they appear, turning to a bright green. They do not fall until late in the autumn or early winter and make but little litter, for they are so fine that those that fall into the grass find their way to the ground. It is free from insect and fungous pests, which is always a strong argument for the planting of any tree.

*Tulip or Yellow Poplar.*—This familiar form grows to be a large tree and should be used only along wide streets and where it has plenty of room. It demands a rich moist soil and plenty of root space. Its leaves are large, a glossy green, turning yellow in autumn; flowers large and tulip-shaped. The tree is not usually affected seriously by insect or fungous pests. However, the leaves are affected both by the gall insect and a fungus, which causes them to turn yellow and fall throughout the season. Since the tree is also susceptible to sunburn, it is doubtful if it should be recommended for planting, unless under favorable conditions.

*Linn or Basswood.*—This species requires a rich, moist soil; grows rapidly and develops an ovate crown. The leaves are large and attractive; the flowers are numerous, creamy-white and appear about the first of July. The tree sunscalds and is much affected by the heat of paved streets. It is attacked by the borer, tussock moth, and scale insects. In some parts of the State the trees have been killed by its enemies. While this tree is a great favorite, it should be used with caution.

*Ailanthus.*—This is a tree of medium size; it is very hardy and adapts itself to all kinds and conditions of soil. It endures the smoke and gases of the city better than any other species. It grows rapidly and usually develops a round head. The leaves are compound, large, a dark green and remain until killed by the frost. It is free from insect pests. The mal-odor of the staminate flowers is an objection to this tree. The ailanthus is recommended when the conditions are such that more desirable species can not thrive.

## SPECIES THAT SHOULD NOT BE PLANTED.

Some trees that may appear to be desirable for street trees are omitted from the preceding list. It will be found that they do not fulfill all of the requirements of a good street tree when the character of the tree is examined, its ability to adapt itself to street conditions or to resist insect and fungous pests. It might be well to exclude from the preceding list the tulip and linn or basswood, not only because they are exacting in their soil requirements and are

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susceptible to insect and fungous pests, but because of the rapidity of decay in case wounds are not properly cared for.

*Red and Silver-leaf or Soft Maples.*—These species have been planted more than the other maples in order to satisfy the desire for quick shade. While it is acknowledged they are of quick growth, they are short-lived. They grow long, slender branches which are frequently broken off by the wind, ice or snow, or are cut off by the "tree pruner," which fits them for the tree surgeon. They are subject to several deadly insect pests which have recently become well established in this State and already many trees have been killed by them. The planting of these species is not now recommended by any experienced city forester.

*Catalpa.*—This tree is not long-lived, and it is difficult to train into a straight trunk and to secure a desirably shaped crown. Rot frequently begins where branches have been pruned off and the trunks split open by freezing. In the winter condition it is not pleasing in outline. In the southern part of the State the foliage is frequently eaten off by the larvæ of the catalpa sphinx. The custom of department stores of distributing gratis thousands of these trees for planting is a case of miguided philanthropy.

*Carolina Poplar.*—This form is too short-lived; it is killed by the oyster shall scale; its leaves fall throughout the season and its roots stop up sewers.

*Silver Leaf Poplar.*—This species is too short-lived and sends up suckers from the roots.

*Osage Orange.*—This tree is too small and is attacked by the San Jose scale.

*Black Locust.*—This well-known form soon becomes a nuisance by the spread of root sprouts and is badly affected by the borer.

*Box Elder.*—This is frequently a crooked and ill-shaped tree and is attacked by many insect and fungous diseases. It has nothing to recommend it, except its rapid growth.

*Horse Chestnut.*—This tree should not be used as a street tree, except where a small form with a round head can be used. It is attacked by several enemies and it is usually necessary to spray it annually. It properly belongs to the ornamental class of trees, for which it is desirable.

*Hackberry.*—The elm is a near relative and could be substituted where the hackberry is used and is much the prettier tree. The hackberry can be used for variety in ornamental planting.

*Evergreens.*—These forms are not suitable for street planting for obvious reasons.



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## THE SELECTION OF TREES FOR HIGHWAYS.

Trees along the highways do not meet such hard conditions as those on city streets, a fact which permits of a wider range of choice. The form of a roadside tree is very important. Our highways are usually wide enough to permit of the use of our largest trees. In fact, they are so wide that only large trees should be used, unless there is a desire to accommodate the telephone companies by growing a small tree that will not interfere with the lines. It is desirable that the trees on both sides of the highway be of one species and that the rows extend at least a half mile or between contiguous crossroads. Tall trees are the best because they can be pruned farther up, which admits sunlight to the roadbed and gives a free circulation of air over it. When the crown of a tree is high the landscape is not obstructed and the shade of a tall tree will not do more harm to the adjacent crop than the same sized crown of a short tree.

A long-lived tree is a prerequisite. The older a tree becomes the more character it acquires. The beauty and majesty of old trees inspires reverence and a sense of the sublime.

Roadside trees should not be highways for the travel of tree diseases or insect pests. For this reason trees should be selected that are as free as possible from this objection. Fruit trees should not be planted or permitted to grow along roadsides, unless they are annually, promptly and properly sprayed. If neglected, they are a means of spreading orchard pests and diseases.

A short discussion of the most desirable trees to plant along highways seems advisable. There is a great tendency to grow along the roadsides nut trees, such as the walnut, butternut and hickories. This practice has the value of the nut crop to recommend it. Further, the nut trees when grown in the open usually do not grow very tall and may be used where a medium sized tree may be required. Their roots also go deep and cultivation may extend to near the trees. The objections to the nut trees are that the fruit is a source of constant annoyance. People trying to gather the nuts not only get the nuts, but usually injure the tree, the adjacent fence and crops. It is not advisable to plant any kind of a nut tree along the roadside.

*Black Walnut.*—This species is the most frequently planted and is the most often permitted to grow along fences. It is believed that this is true not because it is such a favorite but because it is so easily propagated. The land owner when in a happy mood plants

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the nuts and the entire work is done and that too at practically no labor or expense. If trees were planted there would be the labor of digging large holes in hard ground and the expense of buying trees or going to the woods and digging them.

The walnut is not a desirable roadside tree. It generally heads too near the ground and it is quite difficult to train it up without causing injury by pruning. Its leaf period is short and it is often attacked by the tent-caterpillar.

*Hickories.*—What has been said of the walnut may be said of the hickory. However, it can be trained up a little better than the walnut. As a general rule, the crown is not as symmetrical as that of the walnut.

*Sugar and Black Maples.*—These are very desirable, especially where a dense shade is desired. They are long-lived and always have a symmetrical crown. By careful pruning the crown may be raised to any desired height. The merits of these trees are too well known to need discussion.

*Red Oak.*—This species is to be preferred among the oaks, on account of its rapid growth and ability to adapt itself to a moist or dry soil. Its form is generally pleasing and the crown may be easily trained to a sufficient height. It should be ranked as one of the best trees for roadside planting.

*Sycamore.*—The sycamore is one of the desirable trees to plant along highways. It grows rapidly, adapts itself to all kinds of soil, is long-lived, grows tall and stands pruning well.

*Cottonwood* (Populus deltoides).—For a stretch of moist ground the cottonwood is a desirable tree. It is easily propagated, grows rapidly, and has a wide-spreading and arching crown which may be easily regulated by pruning.

*White Elm.*—For grace of form the elm is not surpassed by any tree. It would easily head the list for roadside trees were it not that it is susceptible to scale insects and borers. Then too, it is feared that it will not be many years until the destructive elm-leaf beetle will be introduced into Indiana. It is now in Ohio, and when it once appears in an area only constant spraying will save the trees. It is extremely hazardous to plant the elm in the country, where it is difficult to protect them.

*Biltmore Ash.*—One of the very best roadside trees. (See discussion under street trees.)

*Tulip or Yellow Poplar.*—A very desirable tree to plant. For qualities see discussion under street trees.

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*Linn or Basswood.*—This species would be a desirable tree to plant were it not subject to attack by scale insects. These may be controlled by spraying when the leaves are off. It is a very symmetrical tree, of medium size, fairly long-lived, and the flowers afford valuable food for the honey bee.

*Trees Not to Plant.*—Soft maples, box elder, catalpa, osage orange, black locust. Each of these has qualities which unfit it for roadside planting.

## PLANTING.

The process of planting involves several important steps, each of which will be given some consideration.

*Spacing.*—It is almost universally true that shade trees in this State have been planted too close together. The reason is because the planting is not under expert direction. Each property owner is permitted to plant any kind of a tree his fancy may dictate, and he usually shows his civic pride by planting too many. On a lot with a frontage of seventy feet he will plant from four to six trees.

In general, the spacing of trees depends upon the width of the street, the proximity of the buildings, the location of the trees and the species to be planted. As a rule, no street trees should be planted closer than thirty feet. The greater number of our city blocks are made up of four lots with a frontage of seventy feet each, with an alley of ten to sixteen feet dividing the block. If the walk is along the curb and the first tree is planted fifteen feet from the curb, the remainder of the block could be planted with seven trees, spacing them about forty feet apart. This gives eight trees to a block, allowing sixteen feet for an alley. The number to the block must be governed by the considerations just enumerated. Some species with a wide spreading top like the elm, red oak, sycamore, etc., require fifty feet at maturity. Trees should never touch each other. When trees are planted too close, the vitality of the tree suffers, the beauty of the individual tree is marred and the street effect is that of a windbreak rather than an arrangement of trees for the combined effect of ornament and shade. The trees on the two sides of the streets are usually placed opposite each other, although on very narrow streets the two rows may be arranged in a zigzag row.

*Time to Plant.*—Trees may be satisfactorily planted any time after the leaves fall until the buds swell in the spring. Spring planting is the most successful. Fall planting should never be undertaken if the work can be deferred until spring. Trees planted

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in the fall will suffer much from freezing. Sometimes when the ground around the roots is frozen the evaporation is so great as to kill the tree, or the bark on the windward side will be killed, and have the appearance of sunscald.

If a definite time for planting can be selected, it is best to plant trees that have a surface root system, such as the elm, ash, sycamore, etc., just before they leaf out. If the tree to be planted has a tap root system like the walnut, hickory, oak, etc., it is better to plant it a few weeks before the leaf buds expand.

*Preparing the Hole.*—The hole should be dug and the soil that is to be used in filling the hole should be at hand before the tree is on the ground. The size of the hole of course depends upon the kind of soil, and the size of the tree to be planted. The poorer and harder the soil, the larger the hole. If the tree is to be planted in recently made soil of a good quality it will not be necessary to make a hole much larger than the root system. If the tree is to be planted in a cut where all of the top soil has been removed, for good results, the earth excavated should be replaced by a good black loam. Under such circumstances, for a small tree, the hole should be at least five feet across and three feet deep. The wider the hole the better. The hole should be dug a foot deeper than the root system. The bottom of it should be well packed with a rich soil, mixed with about one-fourth of the amount of well rotted stable manure. The character of the soil used should determine the amount of manure. If the soil is a rich loam, the necessary fertilizer can be applied on the surface. In no case should the roots come in contact with the manure, and fresh stable manure should never be used.

*Obtaining the Tree.*—The majority of the trees planted, except the Carolina poplar and the catalpa, are "wild trees" that have been obtained from the woods. The diameter growth of such trees is usually out of proportion to the height growth for a street tree. When this kind of a tree is planted, the whole crown is usually cut off and the tree is expected to develop a new crown from lateral branches which must start from lateral buds. Under such circumstances, the planter has no idea of the shape of the future tree until after the tree has grown a year or two. If the tree is fortunate enough to survive the transplanting, a permanent wound may be the result of the "topping" of the tree. In the forest where there is room for root expansion, it is common for a tree to develop only a few main roots, which grow to great length. When the tree is

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dug the root system is cut a few feet from the tree, which usually leaves the greater part of the fine or feeding roots in the woods, because they are beyond the place where the main roots were severed. As a result, when the tree is planted it either dies or takes years "to get a start."

Trees should always be obtained from a reliable nursery. The best results may be expected when the best tree available is secured. For this reason, always purchase a transplanted tree and if it is possible to do so, select a thrifty and well-formed tree. If a nursery is near at hand a personal selection of the tree should be made.

The size of the tree to be planted is an important thing. The larger the tree, the greater the expense of planting. The risk, also, is greater because in transplanting a large tree a sufficient amount of the room system is rarely removed. It is wise, as a rule, to plant trees *under* twelve feet in height.

*Care of Trees Before Planting.*—If, however, the trees are obtained from a nearby woods, care should be taken not to permit the roots to become dry. As soon as the tree is dug, the roots should be protected from the air and sun with wet burlap or wet straw.

If the tree comes from the nursery and can be planted at once all that is necessary is to protect the roots with some damp covering. Frequently, the trees are "distributed" to the holes and left unprotected until planted. When this is done sufficient time may elapse to kill the tree by exposure.

If the trees can not be planted as soon as they arrive from the nursery they should be heeled in. This does not mean merely to pile loose earth on the bundle, but that the bundle or box should be opened and the trees placed closely in a trench, located if possible on a north slope. The trench should be dug parallel to the slope to give it better drainage and the roots of the trees should be covered with earth to a depth of twelve to sixteen inches. The tops should be protected from the wind and sun by some kind of shelter of loose boards. Never cover the tops with a straw or corn fodder because the rats and mice may bark them.

*Work of Planting.*—It is best to defer planting until the ground is dry. If the tree is mudded in, enough of the feeding roots will not be in contact with the soil after the soil dries out, and as a consequence the tree either dies or does "not do well."

Do not be careless in the work of planting. Too often the work is entrusted to some one who does not know how a tree should be planted and has little interest in the success of the planting. Em-

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ploy some one who will work as directed. It is best to have at least two persons engage in the work of planting, one to hold the tree firm and vertical and the other to fill in the soil. Before placing the tree in the hole, prune off all of the broken roots. Then set your tree with the main branches toward the southwest. The tree should be planted the same depth that it was in the nursery. The ground usually settles about an inch per foot which will leave the tree three inches deeper than it stood in the nursery. In placing the tree, be careful to get it just where you want it. After filling in the soil do not try to change the direction of the tree by bending; that is liable to break off the roots and loosen the soil from them. After you have the tree in line and have decided the exact position of it, straighten out the roots and begin to fill in by sprinkling loose soil on them. Carefully work it in and *pack* it around the roots. In firming the soil in around the roots be careful not to break them. Imbed every little rootlet in soil. If the ground is dry you can pour on a bucket of water after the hole has been filled to within a few inches of the top. Complete the planting by filling loose earth in around the tree to a depth of three to four inches above the level of the ground, so that when the ground settles the surface will be level. Do not tramp or pack the ground on top. It should be loose in order that it may act as a dust mulch.

Before leaving the tree, the crown should be pruned so as to balance the root system. This may be done before the tree is planted, but it is believed that after the tree is planted a better idea of what branches should be removed may be had. The amount of pruning to be done will depend upon the species planted and the size of the root system when compared with the size of the crown. This usually means that large trees must be severely pruned to secure a balance. It will be found that the smaller the tree the larger will be the root system in comparison with the top, a consideration which is a strong argument in favor of the use of small trees. Trees that have a surface root system with many fibrous roots, such as the maple, will not require so much pruning as those that have a tap root system, or have only a few surface roots. As a rule, from twenty-five to fifty per cent. of the branches should be removed.

The pruning should be confined to the removal of the lower branches and cutting back the laterals. Do not "top" the tree. In doing this work bear in mind that in a few years the lower branches should be removed. A fork should never be left, although for the

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time being, its removal may spoil the symmetry of the crown. A young tree will soon correct its shape. If the fork is left until the tree matures, it may split off and if removed it will permanently destroy the shape of the tree and a large wound will be made which may start a rot. Before the ground settles firmly around a transplanted tree the wind may cause it to grow crooked. For this reason, it should be fastened to a stake set on the southwest side of the tree. The stake should be about ten feet long and driven three feet into the ground, about ten inches from the base of the tree. A round stake about 2½ inches at the large end is to be preferred to a sawed stake. Tie the tree to the stake in at least two places with a small rope, such as is used for a clothes line. In order to prevent the rope chafing the tree it is best to pass some rubber tubing over the rope where it will come in contact with the tree.

*Protecting it with Guards.*—The tree should be enclosed for several years by a guard at least six feet high to protect it from vehicles, animals and the small boy who uses it for a gymnastic pole.

When the tree is young it is best to make a guard out of wood slats. The guard should be about a foot square and may be made out of one by two inch slats. The guard may be anchored to the ground by driving stakes at each corner and nailing it to them. With this kind of a guard is used the tree can be tied to it and the stake be dispensed with. The tree should also have an auxiliary protection. Four stakes should be driven to form a square of about four feet about the tree. The stakes should be two feet above the ground and on them nailed a twenty-four inch width of chicken wire fence. This will serve as an additional protection and prevent the mulch from scattering. The box guard may be fastened to the base of these stakes, avoiding the uses of stakes so near the tree.

It is admitted that to plant and guard a tree as described is somewhat expensive when compared with the old way of buying a tree and getting it planted for a dollar. However, when the final results are compared it will be found that the correct way of planting, which is the more expensive, is cheaper than the hap-hazard way, which is the cheapest in the beginning.

## PRUNING.

After a tree is established it will develop according to the habit of the species in relation to its environment. It generally happens that the development does not correspond to its greatest usefulness.

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Consequently it is necessary to direct its growth so that it will serve its purpose. This necessitates pruning, an operation which requires care, skill and judgment.

*The Time of Year.*—As a general rule, pruning should be done when the trees is dormant,—that is after the leaves have fallen and before the buds swell in the spring. For general pruning, the fall or winter is to be preferred. In late spring when the sap is ascending some specie like the maple "bleed" severely, which prevents the antiseptic dressing applied to the wounds from adhering to them. At this season of the year also the bark on the branches may be loosened by tramping on them in climbing in the tree. Emergency cases may arise when it is necessary to remove one or more large branches from a tree during the summer. In this case it is best to extend the work over as long an interval of time as is possible. This will give the tree some little time to establish an equilibrium between the top and roots.

*The Frame.*—The frame is the skeleton parts of the tree. Much of the strength and beauty of the tree depend upon the frame, which to a great extent can be built to order. The frame will in a large measure depend upon the species. Such species as the oak, gum, tulip and ash, usually develop a main axis with radiating branches, while such species as the maple and elm have a tendency to form two or more co-ordinate axes.

One of the main considerations in this work is to prevent the main axis from dividing. The better way is to watch the tree in the spring and if the terminal starts to fork, remove one branch of it. This method is much more satisfactory than to wait until the end of the season and then remove it. It is well to keep in mind that a tendency in tall-growing trees to form forks is an indication that the tree is growing under adverse conditions. It may be the lack of light or poor or undrained soil. If possible, it is best not to permit the terminal to fork under fifteen feet. The height, of course, will depend much upon the species. If a tree has plenty of room and light there need be no fear that it will grow too tall. The larger a tree grows proportionately, the more desirable it is.

The building of the frame should begin with the planting of the tree. As a general rule, the crown should be at least one-half the total length of the tree, and the trunk of the mature tree should be from one-third to one-half of the total length. (Plate 22.) These proportions will depend upon the species and the location of the tree. A tree should not be "bushy," neither should it be spindling.

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PLATE No. 22. Norway Maples which have been permitted to head too low.

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The lower branches should be successively removed until a height of at least ten feet has been reached. This will allow an unobstructed view of the street, admit the desired amount of light; permit a free circulation of air, beneath the trees and the lower

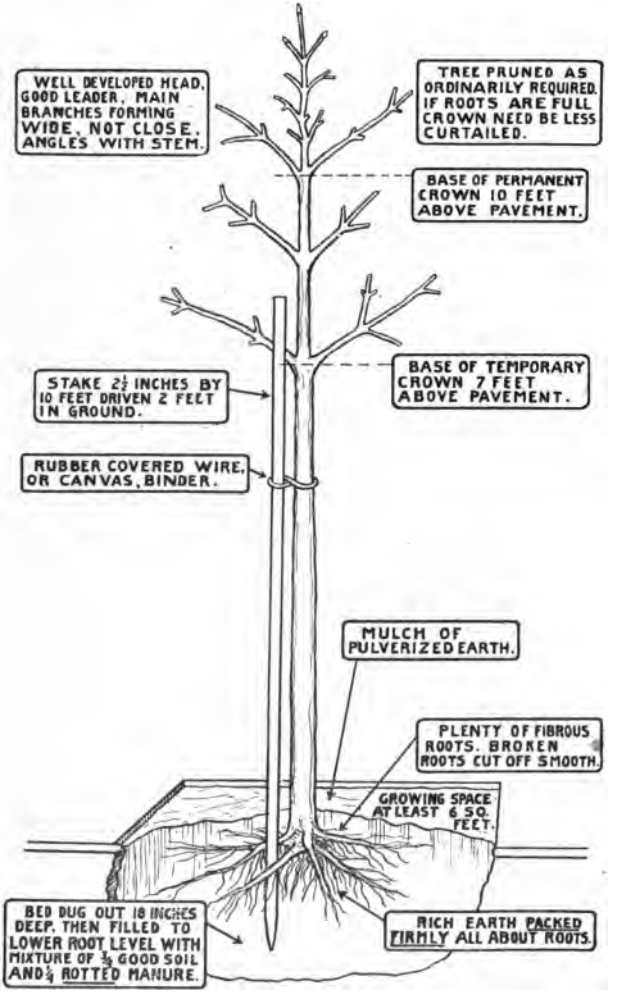
WELL DEVELOPED HEAD, GOOD LEADER, MAIN BRANCHES FORMING WIDE, NOT CLOSE, ANGLES WITH STEM.
TREE PRUNED AS ORDINARILY REQUIRED. IF ROOTS ARE FULL CROWN NEED BE LESS CURTAILED.
BASE OF PERMANENT CROWN 10 FEET ABOVE PAVEMENT.
BASE OF TEMPORARY CROWN 7 FEET ABOVE PAVEMENT.
STAKE 2½ INCHES BY 10 FEET DRIVEN 2 FEET IN GROUND.
RUBBER COVERED WIRE, OR CANVAS, BINDER.
MULCH OF PULVERIZED EARTH.
PLENTY OF FIBROUS ROOTS. BROKEN ROOTS CUT OFF SMOOTH.
GROWING SPACE AT LEAST 6 SQ. FEET.
BED DUG OUT 18 INCHES DEEP, THEN FILLED TO LOWER ROOT LEVEL WITH MIXTURE OF ¾ GOOD SOIL AND ¼ ROTTED MANURE.
RICH EARTH PACKED FIRMLY ALL ABOUT ROOTS.

PLATE No. 23. Diagram—How to plant a street tree.
(By permission of the New Jersey Forestry Commission.)

branches will not interfere either with the pedestrian or the street travel.

The ideal frame is illustrated in Plate 23. The location of the primary branches is important. If possible, they should be trained

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to radiate from the main axis so that their number with their secondary divisions will form a symmetrical crown.

In case the terminal or leader is injured or broken off, select a vigorous side branch which is near to the top and bend it toward the vertical and tie it to the stub of the leader that was broken off. If the stub is not long enough, the branch may be tied to an extension of the stub which may be provided by fastening a piece of bambo or cane to the main axis, letting it extend a few feet beyond the end of the stub. The pole should be wrapped with burlap, or some similar material, when tied to the tree. The fastenings should be passed over pads of burlap in order to avoid chafing the tree. Raffia is the best thing to use for tying. Usually at the end of the season this mechanical device may be removed and the stub sawed off at the base of the new leader. If it is found necessary to keep the new leader tied up the second year the location of the fastenings on the pole should be changed. They may have become so tight as to restrict the growth. If a young tree has formed a wide diverging fork which is below ten feet, it is necessary to remove one branch. This is best accomplished by cutting off the least desirable one at about three to five feet from the crotch. Remove all the branches from it and keep them off, then tie the other fork to it, bringing it to the vertical as nearly as possible. At the end of the season the crippled fork may be removed at the trunk.

It occasionally happens that the terminal is not strong enough to stand erect. In such cases, it should be supported by tying it to a bamboo pole which is strapped to the main axis of the tree. Be careful in tying the pole not to break off any of the branches or leaves from the terminal because they assist in increasing the diameter growth. The successive branches of the primaries should be trained so that they will contribute to the symmetry of the crown and so that they will not rub each other.

*The Form of the Crown.*—The form of the crown should be symmetrical. If there is freedom for development, the crowns of different species will assume different outlines. If possible, it is best to let the form be characteristic of the species. Necessity may require that the crowns be headed back to confine them to the limits of a narrow street or to admit light to buildings. No difference how much it is necessary to alter the size of the crown, the symmetry should be preserved.

The size and shape of the crown is obtained by encouraging short branches to grow longer and by suppressing those that extend

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beyond the outlines of the crown. The art of shaping the crown consists in doing the necessary pruning and leaving the tree to appear as if it had grown naturally.

*The Individual Tree.*—The individuality of the tree should be preserved, except to bring it into uniformity with the trees of the street of which it is a unit. Every tree should be inspected each year to see if it needs pruning. If judicious pruning is done from the time the tree is planted, it will never be necessary—barring accidents—to remove any of the primary branches. After the tree has grown to medium size, the branches removed should be confined to those beyond the second division of the primary branches. Branches that interfere with each other should be removed. Judgment should be used to see that no branch is permitted to grow that will later interfere with another. Dead and diseased branches of all sizes should be removed. The interior of the crown of such trees as the maple requires some light and may need thinning. Do not "top" a tree. (Plates 24 and 25.) If it becomes necessary to reduce the size of the crown, the tree should be headed back, in which case all of the main branches should be uniformly shortened. When an old tree lacks nourishment it will show it by one or more branches of the crown dying. In this case, if it is not possible to change conditions so that it may obtain sufficient nourishment it is best to head it in, which requires considerable skill and judgment. It should be remembered that all species of trees do not have the same power of sending out new shoots where the ends of the branches have been cut off. Such species as the sycamore, tulip and maple, readily send out new shoots, while hard wood species like the oak frequently fail to do so, especially when the branches removed are large. The work of heading in a tree should always be in charge of some one experienced in pruning.

*How to Prune.*—The tools necessary for pruning are not many, usually only a saw is needed. A hand pruning-shears and pole tree-pruner may also be required.

The tree should never be ascended by the means of climbing irons, since they injure the bark.

The workman should begin at the top of the tree and work downward. By so doing he can more easily shape the crown.

Each branch should be cut off close at its base. It should be removed as close as possible and as near as can be, parallel to the plane of the axis of support. The stub should not be longer at the bottom than at the top. The closer the cut the more quickly it will

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PLATE No. 24. Cottonwood (Populus deltoides), which died from the effects of being "topped." Note that a few branches grew the first year.

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PLATE No. 25. An Elm which lived one year after it was "topped." Note the break in the bark near the base, and that the bark is sloughing off on one of the branches.

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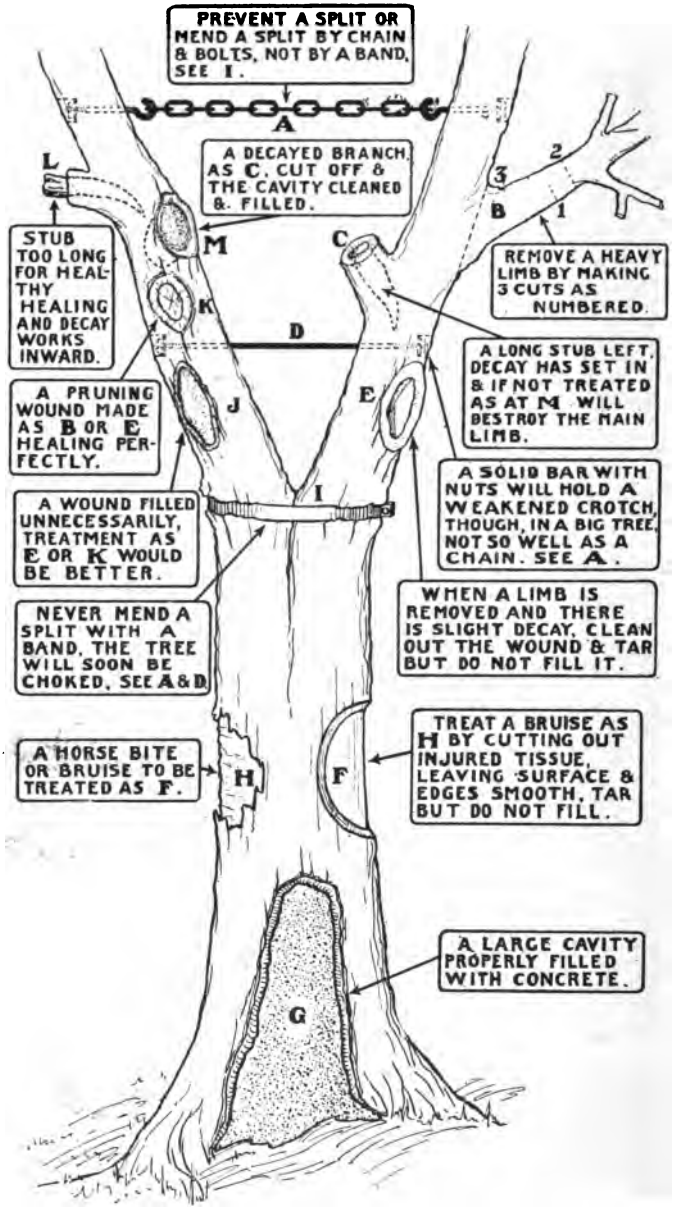
PREVENT A SPLIT OR MEND A SPLIT BY CHAIN & BOLTS, NOT BY A BAND, SEE I.
A
A DECAYED BRANCH, AS C, CUT OFF & THE CAVITY CLEANED & FILLED.
L
M
C
K
D
STUB TOO LONG FOR HEALTHY HEALING AND DECAY WORKS INWARD.
A PRUNING WOUND MADE AS B OR E HEALING PERFECTLY.
J
E
I
A WOUND FILLED UNNECESSARILY, TREATMENT AS E OR K WOULD BE BETTER.
NEVER MEND A SPLIT WITH A BAND, THE TREE WILL SOON BE CHOKED, SEE A & D
A HORSE BITE OR BRUISE TO BE TREATED AS F.
H
F
G
3
2
B
1
REMOVE A HEAVY LIMB BY MAKING 3 CUTS AS NUMBERED.
A LONG STUB LEFT, DECAY HAS SET IN & IF NOT TREATED AS AT M WILL DESTROY THE MAIN LIMB.
A SOLID BAR WITH NUTS WILL HOLD A WEAKENED CROTCH, THOUGH, IN A BIG TREE, NOT SO WELL AS A CHAIN. SEE A.
WHEN A LIMB IS REMOVED AND THERE IS SLIGHT DECAY, CLEAN OUT THE WOUND & TAR BUT DO NOT FILL IT.
TREAT A BRUISE AS H BY CUTTING OUT INJURED TISSUE, LEAVING SURFACE & EDGES SMOOTH, TAR BUT DO NOT FILL.
A LARGE CAVITY PROPERLY FILLED WITH CONCRETE.

PLATE NO. 26. Diagram—How to doctor a tree.
(By permission of the New Jersey Forest Commission.)

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heal over. The base of the branch may be somewhat swollen, which is often an excuse for leaving a very short stub. To cut back close to the support means more labor and a much larger scar, but the success and rapidity with which the wound will heal will amply justify both.

In the removal of large branches three cuts should be made. (See plate 26, letter B.) According to this method, begin by making an undercut about a foot from the base of the branch, sawing until the saw gets tight or about half way through the branch. Remove the saw and begin on the top of the branch a few inches farther out and continue until the branch falls. Then remove the stub. Another method is to begin with an undercut about eight or ten inches from the base and saw as in the first method. Then remove the saw and begin to saw on top near the base until the branch splits off. Finish by sawing off the stub. This method is best for species that split easily or do not have a cross-grained base. Another method is to begin with an undercut as in the two other methods about a foot from the base, then begin on top at the base and saw in about half way. The weight of the branch will keep the saw from "pinching." Then remove the saw and cut the branch off a few inches beyond the undercut. Finish by sawing off the stub. Care should always be taken to prevent the branch from splitting down the tree. The depth of the undercut and its distance from the base must be governed by the size of the branch and the toughness of the wood.

In the process of shortening branches, a "sap lifter" should be left. That is, the branch should be removed just beyond a small branch, which will have the power to elaborate enough plant food to heal over the wound.

*Care of Wounds.*—When a branch two inches or over in diameter is cut off, the wound made should be painted with an antiseptic dressing. Coal tar is most frequently used, because it is satisfactory and is also the cheapest. It should be heated before applying so it will not be too thick. It should be applied with a small brush. In applying the dressing, paint only the wood and do not paint the tissue between the wood and the bark. The wound should have two thin coats or one heavy one. It is better to apply a thin coat and later put on a second coat. Frequently if the coal tar is thick and a single heavy coat is applied, it will be melted by the hot sun and run down the tree. At the end of the season, the wound if not healed should be given another thin coat and so on until the callus closes.

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PLATE No. 27. Sycamore trees which have been injured by horses gnawing off the bark. Cities should enforce the laws which protect street trees.

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Other dressings that are used are heated asphalt, linseed oil paint and liquid grafting wax.

If a tree suffers a mechanical injury (Plate 27) all of the injured wood should be removed, and the edge of the wound be clean cut. The bark should be champfered off at an angle, especially at the bottom so that the wound will not hold water. Then apply the antiseptic dressing to the exposed wood. When a branch is broken off as by a storm, remove the stub back to a crotch.

*Tree Surgery.*—Recently scientific pruning and the filling of cavities has been styled "tree surgery." It is of only recent years that large cavities have been filled with a mixture of sand and cement. Cavities of all kinds should be carefully cleaned out by removing all of the decay and paint with an antiseptic, such as creosote or a solution of sulphate of copper in the proportion of one ounce to one gallon of water. After the antiseptic has dried, the cavity should receive two or three thick coats of coal tar. Great caution should be used in painting wounds to prevent any paint from touching the cambium or green bark. In many species it kills it and carelessness may retard the healing of the wound many years. The paint should not be applied on the wounds too heavily. If it is, the heat of the sun in hot weather will melt it and a ring of the cambium around the wound will be killed by the spread of the paint. Champfer the dead bark on the margin of the cavity to relieve bark pressure, which will facilitate the healing of the wound. Cavities that hold water and large ones in the trunk which weaken it or are unsightly, should be filled. In the treatment of large cavities, after cleaning, drive a few rows of nails near the edge to assist in holding the cement. The cement filling should be brought just to the edge of the wood. If the cavity is large it may be preferable to use a zinc cap. This is fitted by cutting a margin around the cavity about one-half inch wide through the cambium to the wood. After painting the cavity, paint the inside of the zinc and tack it closely to the edge of the cavity, except at the upper end, which should be left free so that the filler may be poured into the cavity. Complete the work by filling the cavity, tacking down the remainder of the cap and painting the outside of the cap with a paint to match the bark. Experienced tree surgeons who are provided with the necessary tools may be easily secured to do this kind of work.

*Forks.*—Frequently trees are permitted to form forks which are liable to be split by the wind. Where there is danger of splitting they should be strengthened by a bolt or chaining. (See A and D,

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Plate 26, which explains the method.) Never use a band on a tree, or permit a tree or branch to serve as an "anchor or deadman" for anything.

### TELEPHONE AND ELECTRIC LINES.

It is evident that street shade trees must be planted along the sidewalk. Telephone and electric light linemen contend that the same place is the logical place for their poles and wires. This conflict has resulted in the butchery of many of our trees. These conflicting interests are, no doubt, in a measure responsible for the lack of spirit in planting trees. The reason frequently offered for not planting trees is that "as soon as I get my trees well started some lineman will come along and ruin them." Now the fact is that the proper location of overhead wires is in alleys and wires that must be used along the street should be carried under ground. At present, commercialism dominates almost every line of human endeavor. Judging from our increased interest in civic improvement, it is believed that our aesthetic education will soon demand that poles and wires be disposed of in the manner suggested. Many cities are now requiring companies to put so many miles of wire under ground each year, and where new lines are being constructed, that they be placed in the alleys. Until this is accomplished there must be some kind of a compromise. When it is necessary to conduct one or more wires through a tree, they should be cabled and taken through as low down as possible. In narrow streets the wires can be elevated and low growing species of shade trees be used. The butchery of trees should not be permitted and legal redress is suggested to mitigate this evil.

### INSECTS.

In the choice of a shade tree one of the most important things is to select one that is as free as possible from the attack of insects and fungous diseases. The subject of insects and fungous diseases injurious to shade trees and their control is not discussed in this report, since it properly belongs to the department of entomology. Information on this subject is contained in the Fourth Annual Report of the Indiana State Entomologist, which may be obtained gratis by addressing that department.

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# Laws of Indiana Relating to Shade and Highway Trees.

(Acts 1905, p. 678. In force April 15, 1905.)

*Vines or Trees—Injury.*

Sec. 2308 (2059), p. 414: Whoever cuts down or destroys, or by girdling or any other means injures any standing or growing vine, bush, shrub, sapling or tree on the land of any other person, or on land belonging to the State, or to any county or township therein, or on any land reserved or granted for the use of schools or colleges, without a license so to do from competent authority, or whoever, without such license, shall cut down or remove from any such lands, or from lands belonging to the United States, any tree, stone, timber or other valuable article, is guilty of a trespass, and, on conviction, shall be fined in five times the value of such property, to which may be added imprisonment, not exceeding twelve months in the county jail.

*Trees on Highway—Injury.*

Sec. 2310 (2061), p. 416: Whoever shall wilfully, maliciously or mischieviously, and without right, cut down or in any way injure any tree on the public highway, shall on conviction, be fined not less than five dollars nor more than five hundred dollars.

*Military and Fire Companies.*

Sec. 4293 (4590), p. 8: To organize military or fire companies; also companies to erect suitable buildings for public meetings, and to plant and protect shade trees in public grounds or spaces in towns and cities.

*Control of Lawns and Trees Along Streets.*

Sec. 8888 (3709), p. 234: Every city and town is hereby invested with full power to regulate the planting, maintaining and production of shade trees and lawns along the streets and in the public grounds of such city or town; and such city or town is given full power to compel the owners of lots and parcels of ground bordering on any such street, alley, public square or common, to plant, maintain and protect shade trees and lawns, under the same regula-



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tions and in the same manner as grading, paving and other improvements of streets and sidewalks are now enforced; and the expense of such improvements, when so ordered by ordinance of such city or town, shall be a lien on such lots and parcels of ground and be collected in the same manner as assessments for street improvements. All laws for the improvement of streets in cities and towns are hereby made applicable to the improvements provided for in this section.

(Acts 1905, p. 232. In force April 15, 1905.)

*Trustees—Powers Defined.*

Sec. 9005 (3797), p. 31: The board of town trustees shall have the following powers:

*Seventeenth.* To plant trees upon public grounds and along the streets of such town, and provide for their culture and preservation.

(Acts 1905, p. 680. In force April 15, 1905.)

*Shade Trees—Destroying or Injuring.*

Sec. 2316 (2065), p. 420: Whoever unlawfully removes, destroys, cuts or girdles any shade tree, or carries off or removes or in any wise injures the protecting box of any shade tree, in any city, town or village of this State, or in any public highway, shall be fined not less than three dollars nor more than fifty dollars; but this section shall not be so construed as to prevent any owner of grounds from making any necessary alterations in the walks or trees on or adjacent to such grounds.

AN ACT concerning highways.

(Approved March 1, 1905.)

*Poles, Wires, Etc.*

Sec. 38. That corporations organized for the purpose of constructing, operating and maintaining telephone lines and telepone exchanges are authorized to set and maintain their poles, posts, piers, abutments, wires and other appliances or fixtures, upon, along, under and across any of the public roads, highways and waters of this State, outside of cities and incorporated towns; and individuals owning telephone lines are hereby given the same authority: *Provided,* That the same shall be erected and maintained in such manner as not to incommode the public in the use of such roads, highways and waters: *Provided, also,* That no pole or appliance shall be so located as to interfere with the ingress or

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egress from any premises on said road, highway or waters: *Provided, further,* That nothing herein contained shall be construed as depriving the county commissioners of any county of the power to require re-location of any such pole, poles or appliances which may affect the proper uses of such highway for public travel, for drainage, or for the concurrent use of other telephone lines; that the location and setting of said poles shall be under the supervision of the board of commissioners of the county.

AN ACT to amend section thirty-eight of an act entitled "An act concerning highways," approved March 8, 1905.

(S. 161. Approved March 4, 1911.)

*Highways—Poles, Wires, Etc.*

SECTION 1. *Be it enacted by the General Assembly of the State of Indiana,* That section thirty-eight (38) of an act entitled "An act concerning highways," approved March 8, 1905, be and the same is hereby amended to read as follows: Section 38. That corporations now formed or which may hereafter be organized for the purpose of constructing, operating and maintaining telephone lines and telephone exchanges, or for the purpose of generating and distributing electricity for light, heat or power, are authorized to set and maintain their poles, posts, piers, abutments, wires and other appliances or fixtures upon, along, under and across any of the public roads, highways and waters of this State outside of cities and incorporated towns; and individuals owning telephone lines or lines for the transmission of electricity, are hereby given the same authority: *Provided,* That the same shall be erected and maintained in such manner as not to incommode the public in the use of such roads, highways and waters: *Provided further,* That no trees shall be cut along such roads or highways without the consent of the abutting property owners: *Provided, also,* That no pole or appliance shall be so located as to interfere with the ingress or egress from any premises on said road, highway, or waters: *Provided further,* That nothing herein contained shall be construed as depriving the county commissioners of any county of the power to require the relocation of any such pole, poles or appliances which may affect the proper uses of such highway for public travel, for drainage or for the concurrent use of other telephone lines or lines conducting electricity. That the location and setting of said poles shall be under the supervision of the board of commissioners of the county.

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# Some Practical Suggestions for the Study of Forestry in the Schools of the State.

The economic importance of our forests and the aesthetic value of trees make a practical knowledge of the planting, care and the products of trees desirable. While the subject of forestry is not specifically given as a branch in the school curriculum, yet it is given considerable attention in the teaching of nature study, elementary agriculture and botany. It is believed that if teachers will use the subjects of the following exercises as themes for study, adding or subtracting as time or material require, that not only valuable practical knowledge would be acquired but the habit of studying the relation of cause and effect would be strengthened.

These exercises are only suggestions and have been arranged to cover the school year from September to April, their sequence being determined by the availability of the material to be studied. Those exercises covering subjects which might be discussed at one season as well as another are assigned to the winter months. However, conditions must determine which ones and how much of each can be used to advantage. If a few field trips only are possible, it may be necessary to combine two or more subjects and make one field trip cover them.

It is strongly urged that a forestry museum be made by each school. Really only an enthusiastic start is needed to realize the object. At least a collection of tree seeds and different kinds of wood of the community should be made. It is also desirable that herbarium specimens be made and some of the interesting products of our native trees should be collected, such as maple sugar, maple sirup, tar, wood alcohol, oil of birch (oil of wintergreen), oil of sassafras, and tannin. Medicinal parts of trees such as the leaves of the chestnut, which is used as a specific for whooping cough; barks, such as from the root of the butternut, barks of the wild cherry, white oak, yellow poplar, flowering dogwood, and slippery elm. The latter are all common drugs and extensively used as family medicines. A collection of photographs illustrating the many subjects of forestry may be made. In making field trips, if the fores



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try museum should always be kept in mind, many additions could be made with little effort. If the teacher will encourage competition among the pupils and classes in adding specimens to the collection, it would not be long before a representative collection would be made. The material collected can often be used in the classroom to good advantage, and the pupils being associated with its formation will add interest and greatly emphasize the importance of the subject of forestry.

## EXERCISE No. 1.

LESSON: The dispersal of tree seeds.

DIRECTIONS: This subject must be studied at different times of the year, whenever the seed or fruit is ripe. The seed of a majority of the trees matures in the fall and the subject may be begun at the opening of the school year. The seed of the elm, cottonwood, and willow must be studied in the spring. Note the different agencies at work in seed dispersal and group the trees under the agency most favorable to the dispersal of their seed.

*Ground Contour.*—Note the effect of an uneven surface in rolling such nuts as walnuts and hickory nuts from the place where they fall. Note the final resting place of seed falling from trees growing on hillsides and on the banks of streams. Is a smooth, hard surface more or less favorable than a muddy and rough surface for seed dispersal?

*Wind.*—Note that heavy nuts such as walnuts and hickory nuts are found in almost a circle around the parent tree and that lighter seed such as the maple, ash, elm and willow are found farther from the parent tree, the seed the farthest from the tree being in the direction of the prevailing wind. Note the difference in an open field and in the dense woods. In the winter when there is a crust on the snow the wind will blow seed a great distance on the crust and on the ice in rivers and on lakes. The seed of what species?

*Water.*—Drop the different kinds of seed into water and note the kind that sink and those that float. How would this result affect the distribution. What effect would heavy rains have?

*Animals.*—Squirrels store nuts for food. What kind of nuts? When carrying a nut what will a squirrel do with it when frightened? Do groundhogs carry any kind of tree fruits? Does the opossum carry any kind? Do birds ever carry nuts in their bills? Birds also eat many fleshy fruits. The pulp is digested but the seed in many cases is not injured and may be carried great dis-

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tances from the parent tree. Note what kind of birds eat tree seed and what kind of seed are eaten.

*Form of the Seed.*—What functions have the wings on such seed as the ash, maple, elm, the hairs on the willow and cottonwood, the bract on the stem of the seed of the linn? Drop a handful of the seed of the linn with the bract on from a height of 10-20 feet and note the area covered by the seed. Collect the seed and remove the bract and drop them again from the same place and again note the area covered by the seed. Do all seeds have some special form of structure favorable to their distribution? Is there anything noteworthy in the way the seed of the witch hazel and honey locust cast their seed? What advantage is there to the tree in having the seed widely scattered?

## EXERCISE No. 2.

LESSON: The bark of trees.

DIRECTIONS: Go to the woods and study the bark of the different kinds of trees with the purpose of learning to distinguish them by their bark characters. First study the bark at a distance. Get the general appearance and the form of the tree, then advance and view it again. You can not always name a tree from a small section of the bark. The bark is usually the most characteristic on the north side of the tree. Why? Is the bark on young trees the same as that on old ones? Has the bark the same characters at the base of the tree as on the larger and small branches? How do you account for the bark on some trees being in ridges? Does this account for the wide and narrow, long and short ridges? Note the color of the bark of trees of the same kind. Does it vary much? Note if it has a "sheen" of color at a distance of a rod or two. Many of the larger trees have a moss growing near the base. On which side is it the most abundant and why? Is the bark on a tree dead or alive? What function does it serve? The bark of some trees contain tannin and is used in tanning. Name two trees native in Indiana used in tanning? The barks of many trees are used in medicine. Name a tree whose inner bark is used in making poultices. Name two trees whose inner bark is commonly used in making cough sirup. What are bottle corks made of?

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## EXERCISE No. 3.

LESSON: The roots of trees.

DIRECTIONS: Find some stumps which are a few years old and obtain permission to dig around them. Have the class provided with spades and a mattock. Work out the root system. This means some labor on the part of the class, but it makes a more lasting impression on their minds, as to the size, length and position of the roots found. If possible, find some trees that have been overturned by the wind, or some stumps that have been pulled by the stump-puller. Examine the root system of the different kinds of trees. Make a list of the trees that have a "tap" root. Make a list of those, the majority of whose roots are near the surface. What advantage would a deeply rooted tree have? As a rule do long-lived trees have a deep root system? What kinds of trees are most easily overturned by storms? Why? As a rule do the roots penetrate the earth as deeply in a dry soil as in a wet one? Go into a wet woods and you will find a part of the main roots of some trees, especially those of the elm and birch, partially above the ground. Why? Why does the elm on low ground so frequently have buttressed roots? Can roots live that are constantly under water? Would it hurt a tree as much in the winter as in the summer to stand in water? Why? When are the roots of a tree the most active? Do they require air? What are the functions of the root system? What are the smallest divisions of the root system called? How do the roots obtain nourishment from the soil? Pull up several kinds of live plants or vegetables. Note that particles of earth will adhere to the roots. Examine very closely what holds the particles. Where are the majority of the "feeding" roots of a tree? What is the relation of the distance of the feeding roots from the body of the tree to the length of the branches? What effect on the growth of a tree would a well developed root system have? What effect, if any, on the growth if one or more of the main roots are severed? How does hoeing around a tree affect its growth and why? How does mulching affect it? In what three ways does the compacting of the soil around a tree, as by stock standing under it, affect its growth? Why do we water the roots of trees? How can a tree get any benefits from a fertilizer scattered on top of the ground beneath its branches?

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## EXERCISE No. 4.

LESSON: The decay of woods.

DIRECTIONS: Go to the woods and cut into old logs. Note which rots more quickly, the sap or heart wood. Find an old log with a part of the bark on and a part off. See if the log is rotten the deeper where the bark is on or where it is off. Why? See if the depth of rot is thicker on the top of a log or on the part next to the ground. Why? Go into a woods where several kinds of trees have been cut the same season. Note if one kind decays more rapidly than another. Go along a rail fence. Is the rail on the ground as sound as the one above it. Why? Go along a line of fence posts, dig down along the side of the posts. Where is the decay the greatest, near the top of the ground or deep down in the ground? Why? If you have an opportunity to examine the posts that are being taken from a fence, do so. Note where the post is decayed the most, and which kind of wood lasts the longest. Examine split posts which have both heart and sap wood. Which has rotted the most? Is this true of all kinds of wood? Go along a stream and find an old log that has been in the water many years. Does it show much decay? Which will last the longer, a log covered with water or one in the open air? Why? Will a board that is constantly kept dry or one that is alternately wet and dry decay first? Why? Does seasoning have any effect on the durability of wood? In your study of decay what have you found to be the most important factor? What can you find out about wood preservatives? How are shingles frequently treated to make them last longer? How are fence posts and crossties treated? What effect will this have on timber supply?

## EXERCISE No. 5.

LESSON: The relation of trees and local forests to wild life.

DIRECTIONS: Study the advantages and disadvantages of birds, animals and insects, whose existence depends at least in part upon trees and forests. Make a list of the birds of your neighborhood that make their home in the woods. Make a list of those that do not migrate. Make a list of those which are of economic importance. Make a list of those which you think do more harm than good. Have the lists made independently and compare results. Would you kill the crow? What would you do with the jay and blackbird? What is the principal food of the red-tailed hawk? Why does the woodpecker explore the bark of trees? The nut

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hatch? Who kills the more birds?—the thoughtless boy or the house cat? Are birds more numerous than formerly? Why? Make a list of the insectivorous birds. Make a list of the seed eaters. Do some birds eat tree buds? If so, what kind? Are the fox, weasel and skunk beneficial animals? Upon what do they feed? How are red squirrels and chipmunks harmful? Are the following harmful or beneficial?? The squirrels, raccoon, opossum, muskrat, and groundhog? Give reason for answer in each case. Of what benefit are forests to certain kinds of insects? When a forest is cut, what becomes of the insects that fed upon the forest trees? Give a striking example where one species, being deprived of its natural food plant adapted itself to feeding upon a cultivated plant of the same family, and now is a pest to every farmer. In what way are some insects beneficial? What species of trees are injured by insects? What is the nature and the extent of injury to each species? What causes galls on trees?

## EXERCISE No. 6.

LESSON: The relation of trees to soil and moisture.

DIRECTIONS: Visit several woodlots and observe the kind of trees in relation to the soil and moisture.

What kind of trees do you find on the following soils? On a hard clay? On a porous clay? On a black loam? On a sandy loam? On a muck? Do all kinds of trees grow on the same kind of soil? Does one species grow on all kinds of soils? Are some species restricted to one or more kinds of soils? Has the amount of moisture in the soil anything to do with the distribution of trees? Note that certain kinds of trees are associated, these are called "tree societies." Name some of them. What is the quality of the land on which the following trees are or have been abundant. The post, black jack, and black oaks? The beech and sugar maple? Ash, shellbark hickory, elm, cottonwood and walnut?

## EXERCISE No. 7.

LESSON: The relation of forests to rain, snow, wind and temperature.

DIRECTIONS: Some of the following observations can best be made in thick woods.

Do forests increase the amount of rainfall? Are there more barriers in the woods to prevent the rainfall from getting into the

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creeks than in a cleared field? What are they? Does the snow melt as quickly in the woods as in a cleared field? Will more of the water soak into the ground produced by snow melting in the forest than in a cleared field? Do trees have the power of diminishing the force of the wind? What are the several rows of forest trees planted around dwellings and orchards in the prairie country called? Why are such trees planted? If the farmer has an orchard surrounded with forest trees, would as many apples be blown off the trees. If the trees were covered with ice, would the forest trees assist in preventing the branches from being broken off? Is it warmer in the woods than in the open? Take two thermometers. Hang one in the center of a thick woods, the larger the woods the better, and hang the other in the shade near the schoolhouse. Suspend both about six feet above the ground. Do they record the same temperature? Make this observation both in winter and summer and note results. In conducting this experiment it is necessary to correct any difference that may exist in the readings of the two thermometers. Place them side by side in the school house, note the difference, if any, which will be the correction. From the preceding observations, where do you think the farmer's woodlot should be located in reference to his buildings and orchard?

## EXERCISE No. 8.

LESSON: The effect and causes of forest fires.

DIRECTIONS: Visit a woods which has not been burned over and others that have been burned over years ago. Note the effect on both young and old trees. Which are damaged the most? Why? Are all species equally affected? Can you tell the direction of the wind when the fire occurred? Usually the bark on the tree is dead for a distance of several feet above the ground. Remove the dead bark. What do you find? Occasionally, you will find "toad-stools" or shelf fungi near the base on the trunks of trees. What do they mean? Is decay liable to extend up the trunk of the tree? Will a tree that is partially girdled by fire grow as rapidly as one that is not injured? How would the burning of the leaves and humus affect the growth? Will the tree miss the plant food furnished by the decaying leaves which have been burned? Does it take many years for a thick leaf mould to accumulate in the woods? Discuss the origin of forest fires. Can they be prevented? If you should discover a woods on fire, what would you do? What seasons of the year are forest fires most likely to occur in Indiana? Why? What

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is the legal significance of a sign posted at the entrance of a woods, reading "No trespassing"?

Write to the "State Forester," Indianapolis, Ind., for a copy of the State Forest Fire Laws and a cloth fire sign, which will be sent gratis. Study them.

## EXERCISE No. 9.

LESSON: The different kinds of woods.

DIRECTIONS: In making this study draw upon your museum material and visit sawmills, planing mills and wood working industries. First note the physical appearance of woods. In making an examination of woods always compare green and seasoned wood of the same kind and note what green wood loses by drying. Note the color of unpolished, polished and varnished wood of the same species. Compare the different kinds of wood. Is there a difference in color between the sap and heart wood? Does the width of sap wood differ in different species. Does the width vary at different ages of the same tree? Generally the woods of the different families of trees have a peculiar odor and taste, especially the green wood. Examine the different kinds and see if you can distinguish them by taste or smell. Compare the weight of the different kinds of wood. Does green wood weigh more than dry? Take a green board, weigh it and measure the length and width. Dry it thoroughly and again weigh and measure it. Compare the results. Try this experiment with different kinds of wood. Take a thoroughly dried board about a foot square. With a lead pencil draw accurately a ten-inch square on the surface. Immerse the board in water about ten days and remeasure the ten-inch square. Is it the same? Use different kinds of wood in this experiment. Take pieces of green wood of different sizes and lay them away to dry. Note that some will "check" more than others in drying. If the pieces are in the form of boards or lath, they will warp more or less. Go to the mill yard where this may be observed in loosely piled boards. Which kind warps the most and which the least? Has this quality any significance? Take uniform pieces of the same kind of wood and dry some in the sun, some in the shade where there is free circulation of air and some in the shade where there is not a free circulation of the air. Note the difference in the amount of checking and warping to determine the proper method of seasoning timber. Note the waste of lumber caused by too rapid drying. Take fresh sections of wood and paint half of the section with linseed oil. Lay

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it away to dry. Will the unpainted part check more than the other? Why? How do you account for the cracks between the boards on the floor and those on the siding of barns? Why are you advised not to place pianos and furniture near the stove or hot air radiators? Take planed boards of ash, elm, hickory, maple, oak, etc., and note if the grain of the wood is fine or coarse, rough or smooth. Which wood takes the best polish? If possible, take samples of the unfinished woods and apply a coat of white shellac, or a light colored varnish. Note how it brings out the grain of the woods. Visit a wood finishing plant and study the finishing of lumber. Visit a planing mill and in both study the working qualities of lumber. Take blocks of wood of different kinds and split them. Which kind splits the more easily. Note if there is any difference in the splitting qualities of sap and heart wood. Try all the species. Take pieces of boards of different kinds of wood and stand on them on your heels and see which shows the heel prints the most distinctly. What is meant by hard wood floors in a house? Study the relative strength and elasticity of woods. Many fatal accidents occur for lack of this knowledge. Which is the stronger, sap or heart wood? Green or dried wood? Doty or sound wood? What is the origin of knots? Do they affect the strength of the wood? It is important that the effect of knots and wood defects upon the strength be studied. For this purpose, select five or six boards of the same kind of timber, of uniform width and thickness, about four inches wide, one free from knots and the others with a single knot near the middle. The knots should be of different sizes and of different degrees of soundness. There should be at least three feet of sound board on each side of the knot. Place two trestles about six feet apart and lay the board on them so that the knot will be half way between the trestles. Pile bricks or other weights on top of the knot until the board breaks. Break all the boards this way, including the sound, sap, heart and doty ones. Which is the strongest and which the weakest? In performing this experiment keep the trestles the same distance apart. Try the same experiment with different kinds of wood. Note the character of the fracture. Do you find tough or brash woods the stronger? Note which kind will bend the most before it breaks. Try and see if a wood will resist more strain with or across the grain. What is the effect upon the stiffness of doubling the width? Of doubling the thickness? If the sleepers under a floor are 2x10 inches, what should be their thickness if the load is doubled? Go to the sawmill

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and watch the process of cutting a log into boards. Make a drawing to show how a log is cut to get a "quarter-sawed" board. Why is it more expensive than an ordinary board? Note what effect paint has on wood. What effect it has on knots. Find some building, such as a barn, from which the paint has almost worn off. Does the paint wear off on the knots first or last? On this same building note if the paint holds the best on sap or heart wood boards. In making an examination of the adhesive qualities of paint, note if paint sticks to some kinds of wood better than others.

## EXERCISE No. 10.

LESSON: The uses of woods and forest products.

DIRECTIONS: Make a list of the uses of the different kinds of woods. Make a list of uses which demand certain kinds of wood. Which are selected on account of their lightness? On account of heaviness? On account of their color? On account of their strength? On account of their toughness? On account of their hardness? On account of their durability? Which kinds of wood make the best fuel? Which is principally used for fork and shovel handles? Which for ax handles? Which is used for the rims, spokes, hubs, tongue and box for wagons? Why is one kind of wood usually used for buggy spokes and another kind for wagons? What kind is used for tight barrels? For baskets? For siding and flooring in houses? For sawed hoops? For fence posts? Visit a sawmill. What becomes of the sawdust? What of the slabs? Are they wasted? Study the prices of lumber. Name some of the high-priced kinds of lumber. Some of the low-priced. Discuss the reasons for the range of prices. What effect do knots have on the price? What effect have sap boards, or boards partly sap, on the price? What effect has the width of a board on the price? The length? What are some of the substitutes for wood?

Besides timber products, the forests yield other products. What trees produce fruit that is used for food? What is the market value of the principal fruits? From what are the following made: Pine tar? Rosin? Alcohol? Turpentine? Maple sugar? Maple sirup? Newspaper print stock?

Name some of the most important medicinal barks, roots, leaves and berries obtained from forest trees and the most important medicinal plants that grow in the woods. What is the market value of ginseng? Golden seal? Virginia snake root?



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## EXERCISE No. 11.

LESSON: How to improve the woodlot.

DIRECTIONS: Visit several woodlots, some that have been pastured and some that have not, some that are thick with underbrush and some that have none.

The first step in the improvement of the woodlot is to keep all kinds of stock out. Sometimes stock is turned into the woods in the winter, thinking it will do no harm, whereas, it does more harm than in the summer. Why? Why should all stock be kept out of the woods at all times? The second step is to remove all or a part of the undesirable trees. Would you cut the dead, damaged and crooked ones? Which would be the more profitable trees to leave—those that grow to a large size and command a high price, or small trees which can be used only for fuel? Make a list of those that you would leave and those that you would cut. In which list would you place the following? The dogwood, water beech, sassafras, ironwood, redbud, witch hazel, wild plum and thorn trees? The brush should be burned so as to do as little harm to the standing trees as possible. Where would you pile the brush to burn it? Would you pile it in a big pile and then burn it? Would there be an advantage in starting a fire and burning the brush as it is cut? Is it dangerous to have a fire in the woods on a windy day? What precaution should be taken on leaving a fire for the night? The third step in the improvement is to plant seed and seedlings in the open places of the woods. What time of the year would you plant acorns? Walnuts? Hickory nuts? How deep would you plant them? How far apart? If you plant seedlings of ash, yellow poplar or locust, what time of the year would you plant them? What is the object of planting seed and seedlings in the open places? Can you grow more timber in a thick woods or where the trees are scattered. Notice trees in the open how near the branches reach the ground, and how high up they are on trees in the thick woods. Do the numerous branches add to or detract from the value of the tree for timber? If there is any land on the farm that can not be farmed, what should be done with it? Is there any land in Indiana that is not submerged that will not grow trees? If you had land which overflows so often that it can not be farmed and desired to plant it to trees what kind would you use? If the land is sterile and so badly eroded that it can not be farmed, what kind of trees would you plant on such land?

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## EXERCISE No. 12.

LESSON: The diameter growth of trees.

DIRECTION: Go to a woodlot that has recently been cut and note the freshly cut stumps. You will see that the wood shows a series of concentric rings of varying width. Each complete ring represents a year's growth. Measure the diameter of several trees of the same kind. Note what the diameter is the first ten years, the second, third, etc., for each tree. Is there any difference in the length between the different decades? Do the trees differ in rate of growth? Can you assign any reasons for the change in rate of growth? What effect would a dry season have on the rate of growth? Which will increase in diameter the most rapidly, a tree growing in the open or one growing in a dense woods? Why? Has the size of the top of a tree anything to do with the rate of growth? Why? Has the quality of the soil anything to do with the rate of growth? Study a number of stumps of several kinds of trees and make the preceding observations. Compare results. Do all kinds of trees have the same rate of growth? If there is a difference, what influence should it have in the selection of a tree to plant?

## EXERCISE No. 13.

LESSON: The reproduction of forest trees.

DIRECTIONS: Go through woodlots, pasture fields, along fences and along the borders of cultivated fields to find young trees or very young seedlings which may be only an inch or so high. What species do you find in a wheat field? What kind in an oats field? Do you find more or fewer in pasture fields and in woodlots in which hogs have been kept? Why? Scan the banks of streams for seedlings. How did the seed get there? Why were they not washed down stream? Go along the bank of a lake or pond. Do you find any young trees growing there? What kinds? Where are they located? If the water surrounds their base, how did the seed strike root? How do you account for so many walnut, hickory, wild cherry, elm and ash along fence rows? Do animals have anything to do with the planting of seed? If so, what kind of animals and what kind of seed do they plant? In what other ways may seed be planted? Do trees bear seed every year? You will notice that there are many thousands of seeds produced to every seedling you see: why are there so few seedlings? Search to find where



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there are a great many seedlings of one or more kinds. What condition has been favorable to their growth? What kind of seed do not all germinate the first year? What advantage is this to the seed? Which seeds usually germinate in the fall or as soon as they mature, the ones with a thin or a thick seed coat? What effect would a forest fire have on seeds with a thin seed coat? What effect on such seeds as the walnut and butternut? You have now been studying nature's way of planting. What would be the effect if man should select well developed seed and plant them in a moist and loose soil? Is nature's way extravagant? Why? What conditions are the most favorable for the germination of seed? When and how should the different kinds of tree seeds be planted? Which kinds show the greatest percentage of germination? If you planted walnuts, hickory nuts and white oak acorns in the open spaces of your woodlot, would they be disturbed by mice or squirrels? If you had open spaces in your woods and desires to have trees grow in them, how would you start them?

A few trees may be best propagated by cuttings, but the majority can not and many will not grow at all from cuttings or rarely do so. In early winter, cut off about ten inches of the ends of the branches of some catalpa, Carolina poplar, willow, oak and beech, pack them in sand and store them in the cellar. Just before the trees begin to leaf out insert them in moist ground at an angle of about 50 degrees and note results. Do they all grow?

A shoot that grows from a stump, no matter how small or large, is called a coppice growth. Go to a clearing to see which species of trees have the most stumps with sprouts on them. Is there any kind that does not have sprouts? Do more of the small, or large stumps have sprouts on them? See if you can find an evergreen with a sprout on it. Which grows the faster, trees from the seed or from coppice shoots? Why? Go into a field recently cleared. What kind of sprouts do you find? Would such sprouts make good trees? Look through the woods to find a tree which has grown from a stump and not from a seed.

## EXERCISE No. 14.

LESSON: The growth of trees.

DIRECTIONS: Dissolve some aniline in water. Eosin is the best and may be purchased in any town by asking for Diamond Dye Eosin red. A good quality of red ink will answer the purpose, but it is much more expensive than the eosin. Cut some twigs from

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different kinds of trees and stand them in the strong sunlight in some of the aniline solution for about a day. A quart fruit jar or a wide-neck bottle will serve as a convenient container. Make both longitudinal and cross sections of the stems of the twigs and note the path of the aniline up the stem. These are the paths traversed by the sap in its ascent. An interesting experiment in this connection is to use cut carnations, and note how quickly the red or other colors that may be used appears in the petals of the flowers, and also to note the effect of the strength of the solution upon the amount of color deposited. The sap is carried to the leaves where it is transformed by them by the action of light into living matter, which is carried down the tree and deposited between the wood and bark. This living matter is added to the tree very much like the bee builds up a comb of honey. Girdle some worthless shrubs or trees by removing a strip of bark about two inches wide. Scrape off the bark until the wood is exposed. Girdle one near the ground, and another about half way up to the top, so that about half of the branches will be below the point girdled. Girdle some before the leaves appear and some after the leaves are full grown. Girdle several kinds of shrubs and trees. Observe if they are all affected alike. Explain the effect of the girdling. Why are some trees harder to kill than others by girdling? Light is an important factor in growth. How is a branch affected that is shaded? Observe some trees that have grown in the open and have never been pruned. In which direction are the horizontal branches the longest? Why? Observe some freshly cut stumps. Measure the radii north and south, east and west and see if they are of different lengths. If so, in which direction and why? Do the side branches of a tree grow farther from the ground each year, or do they always remain at the height where they appear? If the terminal of a tree forks, will the fork appear higher up in a few years, or will it always be at the same height? In the spring take a small tree with smooth bark, cut a notch in the bark one foot above the ground, and another two feet above the first notch. Measure the distance from the ground to the first notch, the second notch, the distance between the two notches and the distance from the top notch to the tip of the crown, and to some of the horizontal branches. In the fall, repeat the measurements. Between what points has the height growth been made? Can a tree that is so badly decayed as to be hollow, live? Why? Does a tree grow the same amount each year? What are the factors that operate to make a variation?

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## EXERCISE No. 15.

LESSON: Shade and ornamental trees.

DIRECTIONS: Visit the principal residence streets, parks and cemeteries, and make the following observations. Does each kind of tree thrive better upon one particular kind of soil than upon others? Cite examples. Do all trees grow with the same rapidity? Observe a row of trees that have all been planted at the same time. What do you note? Do all trees develop the same shaped crown? What effect has the growing of trees close together on the shape of the crown? Are all trees of equal hardiness? What kinds of trees are the most affected by insects? How are the insect pests controlled? Would it be best to plant trees that have no insect enemies? What time of the year should a tree be pruned? In pruning, should the top of a tree ever be cut off? Do the vertical stubs in the top of a tree ever heal over? What are the results of such pruning? Study how wounds heal over. Are trees usually planted too close together, or too far apart? Find some mature trees whose crowns do not touch each other. Measure the distance between them. This will be the proper spacing of this species.

## EXERCISE No. 16.

LESSON: Making preparations for the observation of Arbor Day.

DIRECTIONS: The extent of the work of celebrating this day will depend upon the area and condition of the school ground. If the grounds are small and well planted, the work should consist of a program bearing on the care of trees, shrubs and vines. If the grounds are larger and will allow additional planting, study well what should be planted. Too many trees should not be planted in one year and the area to be planted should not be overcrowded. A liberal planting of climbing vines should be made along the fence and small buildings in the rear to screen them from view. For this purpose select native vines such as the climbing bittersweet, five-leaved ivy, wild grapes, honeysuckles and climbing green brier. A few shrubs or tall wild roses may be used with artistic effect. In the country the children will know where vines may be had. Ask them to bring such an assortment as can be procured. Those desired that can not be obtained in this way may be bought very cheaply. In the digging and planting of trees and shrubs, see that the rules for such work are carefully followed. Do not let the work stop at the school grounds. Extend it to the homes of the pupils. Encourage each pupil to plant something and call it "his." Rarely

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will a parent discourage or prohibit his child from planting a vine, shrub or tree and "calling it all his own."

A. O. DeWeese, superintendent of the schools of Harrison County, of this State, is taking the lead in this work. In a course of study just issued he makes the following requirements:

"4. Before any pupil shall be issued a grade in Botany he must have complied with the following:

a. Each individual pupil shall plant a tree upon the school yard or other public grounds, by the roadside or in some place where the tree may be of public benefit. The tree may be a shade tree, forest tree or fruit tree, but it must be furnished with some protection and carefully and scientifically chosen and transplanted.

b. After the tree is planted direct a letter to the county superintendent of schools, giving:

1. Description of tree and place planted.
2. Comparison of the soil and environment in which the tree was found and place transplanted.
3. Reasons for the selection of this particular tree for this particular place.
4. Protection made and precautions taken in transplanting in order that the tree might be sure of growth.
5. Insect, fungus and other enemies of this family of trees and their control.
6. Probable benefit the tree will be to humanity.

c. On Arbor Day each year that the pupil is in high school and in good standing, direct a letter to the superintendent giving a description of condition and growth of the tree. If the tree has died, then one shall be planted in its place.

It is the purpose of this requirement to have a thrifty, growing tree of public benefit to the people of the county for every boy and girl who passes through the high schools of the county. The educational benefits to be derived are readily seen."

## EXERCISE No. 17.

LESSON: The forest museum.

DIRECTIONS: Objects illustrating every phase of the subject of forestry should be collected. The wealth of material collected will in a measure depend upon the locality, but more depends upon the resourcefulness and industry of the teacher. The subject of forestry is so closely related to agriculture and botany that much of the material collected can be used to teach these subjects. Practi-

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cally the only objection that can be offered to this work is that there is no room for a collection. Such may be the case in rare instances. A modest beginning should be made which will not require much space. A few shelves protected with curtains are sufficient. The trustee will at least provide the material and the teacher and pupils can with pleasure and profit take a lesson in manual training by constructing them. No doubt, if the subject was properly presented to the trustees, cabinet-made cases would be bought, because such cases would be as necessary as other school furniture and supplies. When the pupils are once interested in such an undertaking, it is surprising how enthusiastic and liberal they become in contributing to the work.

*Woods.*—It is desirable to have all of the indigenous woods represented and as many foreign ones as possible to illustrate the different qualities of wood. In the country schools, specimens of at least the principal kinds of woods may easily be obtained through the co-operation of the parents. Ascertain from the pupils what kind each can furnish and assign the work. Direct the work and let the pupils do it. They will learn much of the working qualities of the different kinds of wood in the preparation of specimens. In collecting specimens make them of equal length. They should be at least 18 inches long. Two feet would be better. Do not be afraid the specimens will take up a little room. If you can, get specimens from about the same sized trees. Ten to twelve inches in diameter would be a desirable size. Of course, it is not possible to obtain a specimen so large from some trees such as the dogwood, and it is not necessary to conform to a certain size, but comparisons are freer from error when similar sizes are compared which will be done in studying museum specimens. More attractive specimens can be prepared if the section is cut when it is green and a little longer than the finished specimen is desired and laid aside until seasoned. Then when it is cut the desired length, it will not season crack so badly.

Suppose the finished sections are eighteen inches long. Cut both ends square. Split in halves. Take the one half and smooth the split surface for half its length. Then varnish one half of the smoothed surface. Bevel one end back to within an inch of the diameter to a slant of 45 degrees. Smooth it and varnish one half the surface the shortest diameter. Take the other half of the section or block and split it so that each part will represent one quarter of the block. Split off the heart about two-thirds of the distance from the center. Finish as the first specimen. You will now have

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all possible sections of the wood both finished and unfinished. In obtaining specimens do not take the bark off and be careful not to injure it. Care should be taken to properly label each specimen. Do not use gummed labels, they may peel off. Sometimes tags, if securely tied on, may be used. It is best to print the label on a smooth surface with a hard lead pencil and then varnish over it. Do not use ink, for it frequently spreads. Each specimen should bear a number, the common and scientific names. The number should refer to the museum record book, where should be recorded the exact locality where the specimen grew, habitat, whether from a branch or trunk and if from the latter, the distance from the ground should be given. The date when the tree was cut should be given, and any other data that can be obtained are desirable.

*Forest Seeds.*—Collect at least a pint of seed of each kind of tree seeds and preserve them in glass fruit jars for future study or for a permanent exhibit. After collecting the seed they should be spread out to dry or kept in an open container, such as a paper bag, until thoroughly dried. The seed should be well dried before they are put into glass jars, especially before the lid is fastened on very tightly, or the seed will mould. There are only a few ever greens in the State and they are very local, except the red cedar, but a collection of cones and berries could be made from trees found in lawns and cemeteries. Collect both open and closed cones from the same tree. Dry the closed cones in the sunlight, say inside of a closed window, when the scales of the cones will open. Where are the seed? The collection to be complete should show some seed before they are taken from the husk or pod. One or more pods or seed with the husk on may be placed in the same jar with the seed. In collecting the seed, be sure to ascertain the correct name of the tree that bears it.

*Herbarium Specimens.*—It is desirable that a flowering and fruiting branch of every kind of native forest tree be contained in the museum. These can be used in the study of botany and forestry. The standard size of a herbarium specimen is one that can be mounted on a card board 11½ x 16½ inches. The ends of branches which contain the flowers, fruit, or leaves are cut off and placed between sheets of blotting paper to dry. Before you place the blotter on the specimen, arrange the parts so that they are natural. Turn some of the leaves upside down so that both surfaces of the leaves may be viewed at the same time. If blotting paper is not available, the kind of paper that is used under carpets may be cut to suitable sizes and used. The green specimens may be placed be-

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tween the blotters one upon the other. To prevent the specimens from wrinkling when they dry, a board should be placed on the top of the pile and a weight of 25 to 50 pounds be placed upon the board. The blotters should be replaced every day with dry ones. When the specimen is dry it can be filed away between a sheet of folded paper or mounted on a sheet of white card board, cut 11½ x 16½ inches. A two-ply vellum is the weight usually used. The specimen is attached to the sheet by glue or strapped on with strips of gummed paper or muslin. The scientific and common names, date when collected, exact locality, and other data should be written on the sheet in the lower right hand corner, or better, on a label which should be attached by the upper part in the lower right hand corner. (Plate 28.) Each label should bear an accession number which is recorded in the museum record. Under the number may be recorded data which for the want of space cannot be placed on the label. Remember you can not get too much data on your label.

An interesting method of studying leaves is to make ink impressions of them. This may be done as follows: Provide some printers' ink, a four- or six-inch photographers' roller which will cost about 25 cents, and a piece of plate glass, tin or zinc about a foot square. Place about a teaspoonful of the ink on the slab of glass, tin or zinc and roll it out with the roller until it is very thin and even on the slab. It is not necessary to ink a large area, one a little wider than the roller and about the same length. Place a green leaf or a dried one that has been moistened by laying it between blotters for several hours, on a piece of paper and pass the roller once over it, after having well inked the roller. Then place the leaf on a clean sheet of paper and cover it with the paper on which you wish the impression to appear. Then pass a clean roller or rolling pin over the leaf. It is best to apply as much pressure as you can and pass the roller over but once. Usually, better results are obtained by placing a blotter on top of the paper which is to receive the impression. If it is desired to have the impressions in a book, the leaf can be inverted when it is inked and placed directly on the sheet, but this must be done with care or the outline will be blurred. If the method has been properly followed the resulting impression will show the structure of the leaf to the most minute detail. An interesting feature of this method of preserving leaves is that a series may be shown in a small space. It is also interesting to collect leaves from the same tree, showing as great variations as possible, and preserve the impressions in a book. The variation in the leaf form of a species may be shown by collecting

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PLATE No. 28. A properly-made herbarium specimen. It shows both sides of the leaves, fruit, and two years' growth of the twig.

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leaves from different trees. In the study of botany a series of leaves may be made to show the different leaf forms, leaf margins, apices and bases.

*Photographs.*—Nearly every school has one or more amateur photographers who would be glad to contribute some of their work to the museum. The photographs to be of the most service should be mounted and grouped or filed according to subject. In many instances it may be attached to the specimen in the museum. If, for example, the photograph of a tree, from which a herbarium specimen, a jar of seed or a specimen of wood, is obtained, may be attached to the specimen. In the main, photographs should be supplementary and show things and conditions which museum specimens can not.

## SUPPLEMENTARY READING.

Numerous circulars, bulletins, and books have been published on nature study and forestry, which can be used to good advantage in these studies. The public documents can be obtained gratis. The books are many, some of which are expensive. The list of books selected are those that deal the most directly with the subject and are not high priced.

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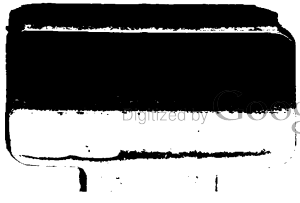

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